

DOCUMENT RESUME

ED 237 332

SE 043 416

AUTHOR Spence, L.; Medlicott, J.
TITLE North Carolina Marine Education Manual. Connections:
Guide to Marine Resources, Living Marine Systems and
Coastal Field Trips.
INSTITUTION North Carolina State Univ., Raleigh. Sea Grant
Coll.
SPONS AGENCY Department of Commerce, Washington, D.C.
REPORT NO UNC-SG-82-1-F
PUB DATE Mar 82
GRANT NOAA-04-6-158-44054
NOTE 97p.
AVAILABLE FROM UNC Sea Grant, 105 "1191" Bldg., North Carolina
University, Raleigh, NC 27650. (Out-of-state, \$2.00;
N.C. Residents, free.)
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)
-- Reference Materials - General (130) -- Reports -
Descriptive (141)
EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Educational Resources; Elementary School Science;
Elementary Secondary Education; Environmental
Education; *Field Trips; Information Sources;
Instructional Films; *Marine Biology; *Marine
Education; Outdoor Activities; Program Descriptions;
*Resource Materials; *Science Activities; Science
Education; Secondary School Science; Weather
IDENTIFIERS *Aquariums; *North Carolina

ABSTRACT

This collection of teaching and resource materials is designed to help middle school teachers put marine perspectives into their lessons. Materials are organized into three parts. Part 1 describes the preparation and maintenance of brackish water aquariums, marine aquariums, and touch tanks. Activities related to and sources of information on keeping a brackish or saltwater aquarium are included. Part 2 includes information on: the focus of marine education; University of North Carolina Sea Grant College Program; North Carolina 4-H Program; weather awareness resources; and organizations interested in North Carolina natural resources. Also included are lists of: bulletins, journals, and magazines (with sources and current costs); film companies; North Carolina films; North Carolina state government resources (with descriptions); federal government resources; and marine career resources. Part 3 includes: a guide for planning educational field trips throughout coastal North Carolina (includes such information as places to visit, their location, expenses, reservations, exhibits, medical services); federal/state fish hatcheries and museums/science centers; bibliography of reference guides for field trips; and suggestions of ways to avoid the liability problems associated with field trips. All activities described can be modified for use with upper or lower grades. (JN)

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

This document has been reproduced as
received from the person or organization
originating it.
☐ Minor changes have been made to improve
reproduction quality.

• Points of view or opinions stated in this docu-
ment do not necessarily represent official NIE
position or policy.

Connections

Guide to Marine Resources,
Living Marine Systems and
Coastal Field Trips

North Carolina Marine Education Manual

L. Spence
J. Medlicott

"PERMISSION TO REPRODUCE THIS
MATERIAL IN MICROFICHE ONLY
HAS BEEN GRANTED BY

Lundie Spence

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)."

UNC Sea Grant Publication UNC-SG-82-I-F

March, 1982

Residents of North Carolina may request a single copy free of charge. There is a charge of \$2.00 for out-of-state requests.

Copies are available from: UNC Sea Grant
P.O. Box 5001
North Carolina State University
Raleigh, NC 27650-5001.

NORTH CAROLINA MARINE EDUCATION MANUAL

CONNECTIONS

Guide to Marine Resources,
Living Marine Systems and
Coastal Field Trips

LUNDIE SPENCE
UNC Sea Grant College Program

JAYNEE MEDLICOTT
4-H Marine Awareness Project

This work was sponsored by the Office of Sea Grant, NOAA, U.S. Department of Commerce, under grant number 04-6-158-44054, and the North Carolina Department of Administration. The U.S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyrights that may appear hereon.

Sea Grant Publication UNC-SG-82-1-F

March, 1982

ACKNOWLEDGEMENTS

The North Carolina Marine Education Manual is a collection of teaching materials generated by North Carolina public school teachers and university professors under a University of North Carolina Sea Grant College project entitled "Man and the Seacoast." Dr. Dirk Frankenberg is the principle investigator; the Resource Unit Development Committee project directed by Dr. William Rickards of North Carolina State University assisted with material production. The manual is designed to help middle school teachers put marine perspectives into their lessons. The activities can be modified for higher or lower grades.

This manual consists of separate units which cover environmental aspects of the coast such as geology, ecology, and seawater interactions and motions. Additional units cover facets of coastal communities and economics, history, anthropology, art, folklore, and literature. An appendix provides information on keeping aquaria, state and federal agencies, field trip guides and film company addresses.

We wish to acknowledge the cooperation we have received from other marine education projects, North Carolina Marine Resource Centers, North Carolina Department of Public Instruction, National Marine Education Association and many people who have contributed suggestions and opinions. We wish to especially thank those people whose enthusiasm and contributions made this project possible -- the following North Carolina teachers:

1977 "Man and the Seacoast" teachers

Charlie Baker, Wells Baker, Edna Bell, John Britt, Fay Edwards, Marie Farris, George Glasson, Gwendolyn Guerrant, Clayton A. Harpold, Linda L. Helms, Katherine Helsing, Jan Jones, Connie Long, Lillie R. McInnis, Martha S. Mallard, Mary Olson, Laurie Oppenheimer, Donna Parrish, Barbara Ratliff, Julia Tingle, and Susan Warren.

1977 "Man and the Seacoast" staff

Dr. David Brower, Dr. Dirk Frankenberg, Dr. Richard King, Dr. Jerry Machemehl, Dr. David Phelps, Dr. James Sabella, Dr. John D. Seelye, and Dr. William N. Still. Graduate assistants: Johanna Bazzolo, Mike Duncan, and Joe Gutierrez.

1977 "Resource Unit Development Committee"

Pat Francis, Allen Lenk, James Futrell, Ron Ferrell, Avonne Williamson, and Ann Watkins.

Special thanks to those authors who have contributed their time in writing special sections: Bob Goldstein and Manley Midgett.

The North Carolina Marine Education Manual developed through the interaction and involvement of people interested in marine education. UNC Sea Grant would like to continue the involvement by inviting your opinions and suggestions for topics and activities. In this way, we can remain responsive to your needs with new additions to the manual.

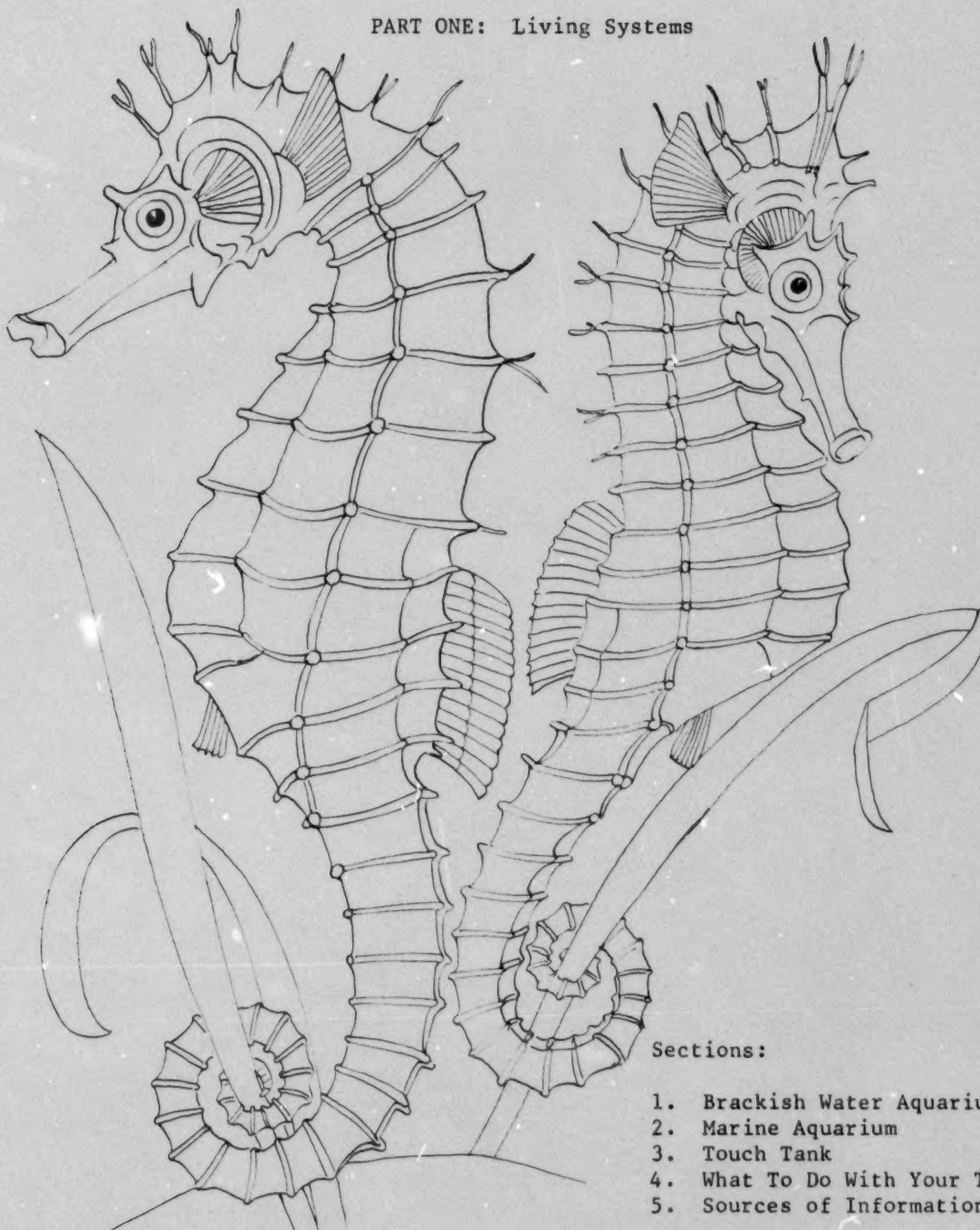
Please address your comments to: UNC Sea Grant College Program
Marine Education Specialist
North Carolina State University
105-1911 Building
Raleigh, NC 27650

CONNECTIONS

TABLE OF CONTENTS

Acknowledgements	i
Living Systems	1
Brackish Water Aquarium	3
Marine Aquarium	14
Touch Tank	17
What To Do With Your Tank	22
Sources of Information	24
Resources and References	27
Going to Sea: Focus on Marine Education	29
UNC Sea Grant College Program	35
North Carolina 4-H Program	37
Weather Awareness Education.	38
Organizations	42
Bulletins, Journals and Magazines	43
Film Companies	45
North Carolina Films	46
N.C. State Government Resources.	48
Federal Government Resources	58
Marine Careers Resources	61
Field Trip Information	63
Shifting Sands	65
Statewide Field Trip Sites and Resources	83
Reference Guides for Field Trips	86
Educators Field Trips and Liabilities	89

PART ONE: Living Systems



Sections:

1. Brackish Water Aquarium
2. Marine Aquarium
3. Touch Tank
4. What To Do With Your Tank
5. Sources of Information

C 1973 Dover Publications, Inc., NY. Seashore Life Coloring Book,
Illustrations by Anthony D'Attilio.

SECTION ONE

BRACKISH WATER AQUARIUM

A brackish water aquarium is simple to set up, maintain and cheaper to operate than a marine aquarium. It illustrates the type of ecology, particularly the animals, which is typical to North Carolina's sounds and estuaries.

Most aquarium systems try to picture life in the sea from those found within a coral reef community. Coral reef fish and invertebrates are beautiful, but few of us have the opportunity to explore reef environments in the southern latitudes. A more realistic aquarium which has more educational value would illustrate North Carolina's waters.

The four most typical communities of animals inhabit the waters near the beach, in the estuaries, in marshes and on or around rocky substrate or piling. Most animals living near the beach, e.g., mole crabs, sea perch, conquina clams, do not survive well in most aquaria. Consequently, emphasis is on the estuary, marsh and solid substrate communities. These are usually in river-diluted sea water, which is not nearly as salty as the ocean. This type of low salinity water is called "brackish," thus the brackish water aquarium. For more information on estuarine environments, refer to Unit III, Ecology (Mauldin and Frankenberg, 1978, UNC-SG-78-14-C) and Seacoast Life (Spitsbergen, 1980, North Carolina State Museum of Natural History).

I. CHOOSING THE AQUARIUM TANK:

Aquarium size: 20-gallon, all-glass tanks are suitable. Larger sizes provide more space for both inhabitants and substrates and more stability. For some exercises, one-gallon, wide-mouth jars can become small aquaria. Remember that the water environment is easily disturbed in this amount of water. Because the water is "brackish" not sea strength, aquaria which are not all glass are also acceptable.

Costs: All-glass aquaria generally retail at about one dollar per gallon up to 50-gallon size. Then the cost increases dramatically due to the higher quality glass required.

II. WATER QUALITY SYSTEMS:

Brackish water aquarium systems do not require the high degree of filtration and circulation of the marine aquarium. Elaborate undergravel filtration is not necessary.

Filtration: Filtration in the large aquarium removes only particulates and provides a good current to break the surface tension and allow

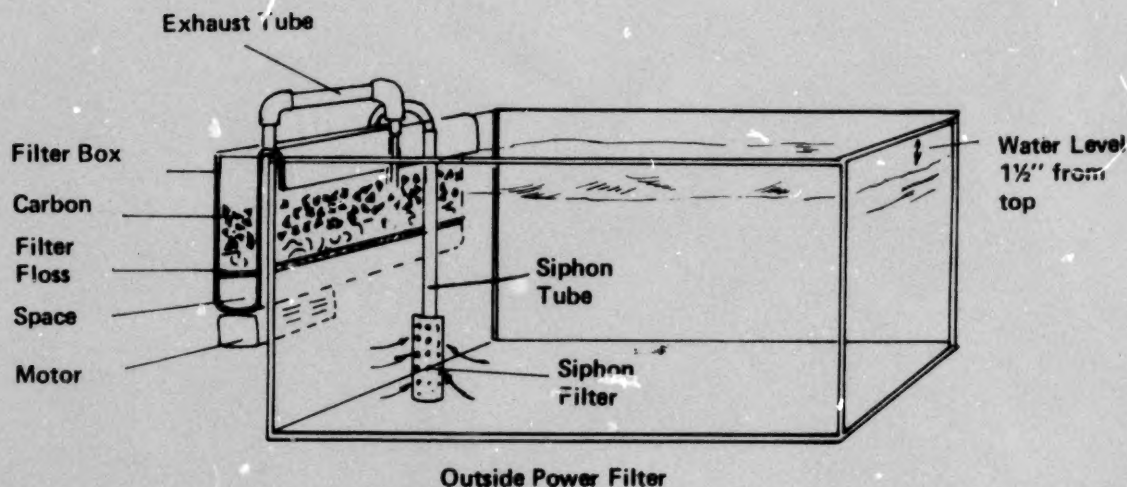
the free exchange of gases to oxygenate the water. Additional processes keep the bacterial balance to maintain water quality. Filtration is not a substitute for water changes.

To remove particulates, an outside power filter should be attached to the side of the aquarium. There are many brands on the market, but type is more important than manufacturer. Recommended is the direct drive filter which sets up its own siphon by the intake tube's abutment to a well inside the filter near its bottom. Below will be a magnetic-driven impeller that pulls water into the aquarium, even when the water level is far below normal. The latest models have magnetic pumps with no moving parts. Among them are the Hagen AquaClear 1200 and the Living World Dynaflo Power Filter 10/20.

Some filters have compartments for filtering material. In such cases, one compartment can be maintained with a filter floss that is allowed to become impregnated with dirt and is occasionally rinsed under a running tap, but never thoroughly cleaned. "Dirty" floss in the outside filtration unit is important as a bacterial bed. A reasonable substitute is the use of an inside box filter with floss and/or shell hash, powered by an air pump. This provides a small area of undergravel filtration to contain the bacterial population, thus freeing the outside power filter for action on particulates only.

Air pumps retail from five to 25 dollars, with the smaller ones just as effective as the larger ones, but pumping less air. Outside filters range from \$15 to \$50 or more for the very large units, but the less expensive ones are quite adequate for the brackish aquarium.

Water Source: Water source for a brackish aquarium can come from the coastal habitat itself or by diluting synthetic sea salt mixes.



Brackish water from sounds and tidal creeks is about half to one-fourth amount of salt as found in the open ocean. Ocean water is about 3.5% salt, usually noted as 35 o/oo (parts per thousand) or having a specific gravity of 1.025. A hydrometer is an inexpensive instrument obtainable from aquarium shops or biological supply companies to measure salinity in specific gravity (Figure 1).

Figure 1. Specific Gravity Unit Reflect Salinity

<u>Hydrometer Reading</u>	<u>Salinity at 65° water temp.</u>	
sp.g 1.000	0	Freshwater
1.005	8.2%	
1.012	17.4% o/oo	Brackish
1.018	25.4%	
1.025	34.5%	Seawater

Estuarine animals can tolerate a wide range of salinities (8-26 o/oo), while many fresh water animals are restricted to water less than 7 o/oo and man, oceanic fish and invertebrates cannot tolerate salinities much less than 26 o/oo for extended periods.

Mixing Brackish Water: To mix water with sea salt for a desired salinity requires some calculations. Accuracy is determined with a hydrometer. This is a good math exercise for students.

Determine volume of aquarium: (1) measure inside dimensions (height, width and length) in inches, (2) multiply height, width and length, then divide by 231 (231 inches/gallon). When measuring dimensions, subtract one inch for clearance from rim and 2-3 inches from bottom to allow for displacement of gravel and other objects (Figure 2).

Figure 2. Mixing synthetic brackish water from sea salt

<u>Weight (@ one pound)</u> <u>sea salt</u>	<u>Gallons Water</u>	<u>Specific Gravity</u>
one pound	3	1.025
one pound	6	*1.012
one pound	12	*1.005

* Brackish water range

Cycling Aquarium Water: Any aquarium, whether freshwater or marine, will undergo a bacterial alteration during the first weeks. Two types of bacteria multiply to handle the animal waste. One changes the very toxic ammonia from urine to the less toxic nitrite. Another changes nitrite to the non-toxic nitrate. Nitrate will build up to an unhealthy amount unless absorbed by aquatic plants or removed by partial change of aquarium water.

Although some algae in an aquarium is healthy, too much is unsightly. Some algae will be consumed by fish or invertebrates, but then recycled by the ammonia again. Most algae can be removed by scraping it from the glass.

A good practice is to change a quarter of the water once a month, or even better, to change the same amount every two weeks. This keeps nitrogen levels and other pollutants low by dilution. It also enhances the health of the aquarium by stabilizing the pH and replacing trace elements used by the animals.

III. LOCATING AND SETTING UP AQUARIUM:

Location of the aquarium: Some indirect sunlight is important to promote the growth of green and brown algae, yet positioning near a window can encourage excessive growth. Position to protect from extreme heat or cold.

Light source: Artificial light can be used to supplement natural light. This requires the use of an electric timer, which turns lights on and off for a total exposure of 8-10 hours. Plant-stimulating fluorescent lamps should be avoided as they promote the growth of noxious blue-green algae. Cool white or warm white fluorescent lamps are suitable and incandescent light (uncolored bulbs) is considered very suitable, although they provide a source of heat. For either type of lamp, a ratio of five watts per gallon should provide sufficient supplementary light to maintain a reasonable growth of green and brown algae. If an acrid odor is detectable by close inspection, assume that blue-green algae are proliferating and either increase the wattage or change the quality of the light away from fluorescent-derived red rays. Blue-green algae are seldom a problem with incandescent lighting.

Protection: The aquarium must be protected to avoid potential problems in a classroom environment. First, it requires a stable platform such as a sturdy table or, in the case of aquariums over 20 gallons, a heavy iron stand. It should be out of the stream of traffic, including walkways, corridors or doors.

The aquarium should be covered with a glass top to prevent salt spray from reaching the source of artificial, supplementary light and to prevent the accidental or purposeful introduction into the aquarium of foreign materials. Finally, it will occasionally prevent an inhabitant from leaving the aquarium.

Temperature: Because the aquarium is stocked with native animals subject to a wide variety of temperatures, no heater is necessary as it would be for a tropical aquarium. However, in order to promote breeding activity, especially during the colder months, supplementary heating may be required. A thermostatically controlled electric aquarium heater, with the tube length appropriate to the depth of the aquarium is best. The generally accepted ratio is five watts per gallon for a tropical aquarium, and this is also suitable for a brackish aquarium up to 20 gallons (100 watts). Beyond 20-gallon size, increase the wattage by half

this rate (40 gallons, 150 watts), and never exceed 150 watts per heater. It is better with large aquariums to use two or three heaters located at different points along the back of the aquarium. Then, a malfunctioning thermostat will be unlikely to overheat the aquarium or allow it to cool down too far.

IV. SUBSTRATE:

Choosing the substrate: As a brackish water aquarium is home to brackish water inhabitants, the set-up of the bottom material of such an aquarium appears to violate the simulation of the natural environment. Most estuarial organisms are associated with sandy, sand-mud or mud bottom habitats, typically with aquatic grasses or shellfish rubble. Grasses, while important as food, substrate, territory markers and hiding places, would not be used in an aquarium. The less organic material used in the aquarium, the lower the probability of sudden decay and destruction of the community.

An ideal substrate for a large aquarium (20 to 50 gallons or more) consists of a thin layer of sand and gravel mixed with crushed shell, no more than a half-inch in depth and preferably not that deep. The shallower the layer, the more likely it is to remain rich in oxygen. It is only necessary to provide a granular surface of shifting materials, not to provide any depth to this surface. A small amount of garden soil may be added, in the rough amount of one cup to two square feet of bottom surface. Certain fishes and invertebrates use soil (mud, silt) in feeding, as a source of food (many organisms will grow in the material) or for mastication. In addition, the dark coloration will enhance the coloration of the fishes by causing them to adopt darker coloration than they would display if they were restricted to a light background. This is different from a marine aquarium in which a 3-inch substrate is recommended.

If a field trip can be arranged, this association to light and dark substrates should be pointed out to the students. Light backgrounds, such as open sandy beaches, will yield primarily silvery or pale animals, while dark backgrounds, such as the various habitats in the sounds, will yield a variety of dark and light colored, and often very strikingly colored animals.

A bare bottom aquarium is not desirable because it is not natural and fails to provide sand for mastication in the intestines of the inhabitants. Deep sand or mud tends to develop pockets of anoxia, where anaerobic bacteria grow, producing hydrogen sulfide gas ("rotten eggs" smell) and acids which may lower the pH of the aquarium water from its normal alkaline range of 7.4 - 8.0 into the acid range (below 7.0). This will stress and eventually kill the aquarium inhabitants. Thus, deep substrates should be reserved for investigative purposes in gallon jar aquariums.

Decorations: Decorations serve no purpose in a brackish water aquarium. On the other hand, judiciously selected materials can both enhance the attractiveness of the aquarium and provide territory markers, spawning substrates, hiding places and behavior stimulants to the fishes and invertebrates. Seashells are most natural, if used sparingly, but often serve to collect decaying materials which can affect the pH of the aquarium. Certain unnatural materials can provide refuge and behavioral stimulation for the inhabitants without the risks of natural materials. Non-metallic rocks, such as quartz and sandstone, can be used to construct caves and rubble piles, but free access should be provided to the fishes and invertebrates so that they can pursue foods that become lodged in the corners.

Rubble piles should consist of only a few layers of large rocks, thus assuring free water passage and inhabitant access to all parts. Bricks with holes make excellent caves. PVC pipe of various dimensions can be cut into short segments of three to six inches to serve as caves. Synthetic knitting materials such as nylon or orlon yarn can be bundled and cut into mops and floated with a cork or a piece of styrofoam or allowed to remain sunken on the bottom. This material will be accepted by many fishes as a plant substitute for spawning. Thus, a combination of hard substrate caves and yarn mops should provide just those materials which will allow the fishes to conduct reproduction in the brackish water aquarium. This aspect of the brackish water aquarium is readily designed and almost invariably successful, and greatly increases the value of a brackish aquarium over a marine aquarium, in which breeding is a rare event.

After all substrate and decorative materials have been added and displacement is complete, the water level can be marked on the outside of the tank with a marking pen. When the level drops from evaporation, it is brought back with tap water.

V. STOCKING THE AQUARIUM

Two options exist for stocking aquariums: collect your own creatures or purchase them from a fish shop, bait shop or scientific supply house.

Scientific supply houses provide a wide assortment of brackish and marine animals, which should be judiciously selected for normal habitat (estuary vs. ocean), predatory behavior or omnivorous habits, cost and principles to be demonstrated. For these reasons, there is no adequate substitute for the field trip.

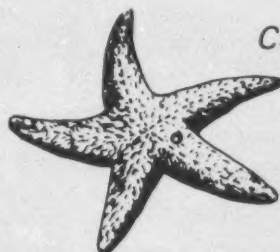
Initial stocking of the aquarium requires care. During the first two weeks after establishment of the aquarium system, only the hardiest of animals should be introduced. These animals have to tolerate higher ammonia and nitrite levels present in the new water. For example, marsh killifish and grass shrimp are much better than snails, starfish, sea cucumbers, silversides, lookdowns, clams and oysters. It is important

to introduce only a few creatures initially. Once the first animals have been introduced successfully, wait about two more weeks before stocking others. Note: the number of animals in aquaria is crucial to its health. A rule of thumb is one inch of animals per one gallon of water.

Mud Snail
(*Nassarius*)



Common Atlantic
Sea Star
(*Asterias*)



Brackish Water Aquarium Inhabitants:

Fish -- Killifish family, livebearing family, goby family.

Of the killifish, the marsh mummichog (*Fundulus heteroclitus*) is especially hardy and inexpensive. Native to this coast, it is found naturally in tidal marsh creeks and is easily caught in minnow pots or small mesh seines. It is often sold as a baitfish in tackle shops under the name of killifish, killy, bull minnow or gudgeon.

The sheepshead minnow (*Cyprinodon variegatus*) is another native marsh fish also found in tackle/bait shops. Males are gaudy with metallic blue napes and red or yellow fins with black edging. Both sexes have mottled sides. This species spawns readily in sunken yarn mops.

The striped killifish (*Fundulus majalis*) is not as hardy as either of the other species, is more often found on sandy bottoms and in higher salinity waters and is not a ready spawner. It too is commonly sold as bait and can be recognized by horizontal or vertical thin black lines on the flanks of the fishes, the direction of the lines denoting sex or maturity.



Sheepshead Minnows (Cyprinodon)



Common Minnow (Fundulus)

Livebearing fishes are familiar to aquarists who have kept such examples as guppies, platies, swordtails and mollies. Two native livebearers are the sailfin molly, found along the southern coast of North Carolina, and the mosquitofish, common in fresh and brackish water all

along the coast and inland. The sailfin molly (Poecilia latipinna) is available in pet stores, as are hybrids of this with related species, in a variety of colors from albino to gold to green to black. Native mosquitofish (Gambusia affinis) are not sold in pet stores, but may be found in almost any backwater or pond in the Piedmont and Coastal Plain. It looks much like a colorless guppy, but occasionally melanistic males are found and these are very attractive.

Gobies can be purchased through scientific supply houses, but are especially attractive and appreciated when collected on field trips. They are found typically associated with hard bottoms and tight crevices, such as within dead shells or living sponges or among discarded cans and tires.

Breeding. The livebearing fishes will produce broods of young approximately every six to eight weeks in warm water, when well fed. They can be placed in gallon jars when heavy, in anticipation of dropping the spawn. If not removed to a separate aquarium, there is the likelihood that the fry will be eaten by the other aquarium inhabitants.

Killifishes, especially sheepshead minnows, will spawn in yarn mops. The eggs can be picked out with the fingers and placed in shallow dishes for hatching, or the entire mops can be removed to separate gallon jars for hatching. The latter method is more convenient, but less instructive. Certain killifishes, such as the rainwater killifish (Lucania parva), another native, prefer floating yarn mops.

Gobies typically spawn in caves, with the male guarding the spawned eggs until hatching some two weeks later. Gobies generally require a minimum temperature of 70° F. to stimulate spawning, although they will go through various phases of prenuptial behavior at lower temperatures.

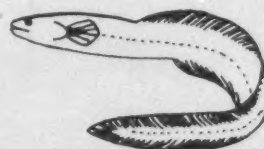
Raising the fry. Livebearer fry can be raised on powdered commercial fish food preparations, although they do better on live baby brine shrimp. Killifish fry require live baby brine shrimp. Brine shrimp eggs and instructions for hatching them can be purchased at any pet store.

Goby fry are very small when hatched and require both a moderate current to keep them in the water column (they are planktonic) and food much finer than baby brine shrimp. This can be provided with the creatures that thrive in green (algae-dense) water. A separate brackish aquarium should be established (one gallon is sufficient) that is rich in garden soil and which receives intense light. Under these conditions, the water will shortly become green with floating algae, and protozoa will graze on the algae. These protozoa, while not visible to the naked eye, will be sought by baby gobies during the first week of life. It can be dripped into their own gallon aquarium several times a day, sufficient to keep the goby aquarium slightly cloudy, but not opaque. At the end of a week, the baby gobies should also be given baby brine shrimp, but the green water feeding should continue for at least two more weeks. Only when the baby gobies are observed to have pink bellies, indicating consumption of brine shrimp, may the green water feedings be terminated.

Mullet. Small mullets (2" - 4") are occasionally caught with dip nets or other gear in coastal ponds and tidal creeks. They make excellent aquarium fishes and can be educational inhabitants of the brackish aquarium due to their unusual style of feeding. Mullet are detritus feeders and algal grazers, and both behaviors can be observed in aquaria.

Eels. Young American eels are commonly collected in coastal habitats. They are enjoyable for a while, but tend to grow too quickly and too large. They also have a tendency to escape aquaria at night when they are most active. They always bury during the day, and for these reasons, American eels are less desirable aquarium fishes.

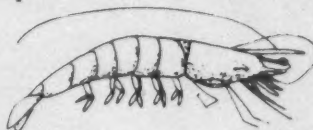
Eel (Anguilla)



Flounder. Several kinds of flatfish are found on our coast. Most of them require living foods and are thus not good aquarium inhabitants. An exception is the hogchoker, a member of the sole family. This small flatfish will feed on certain non-living foods. It is a commonly sold fish in pet stores, under the name "freshwater flounder."

Invertebrates: arthropods, coelenterates, echinoderms. Invertebrates, especially arthropods, e.g., crabs and the small, dark-colored mud crabs found, are useful aquarium inhabitants. Hermit crabs are especially delightful. Fiddler crabs tend to attempt escape in the aquarium and are more at home in an amphibious habitat. Small blue crabs are fascinating to watch as they are quite active and go through molts quite frequently. But they are very predaceous. Thus, they will eat other aquarium inhabitants and disturb the substrate. Small horseshoe are excellent aquarium creatures and spider crabs work well, also. Most oceanic crabs do not survive, including calico crabs and mole crabs or sand fleas.

Grass shrimp (*Palaemonetes* sp.) can be collected along the edge of a marsh creek or bought from biological supply houses. They are detrital feeders and also eat brine shrimp.



Grass Shrimp (Palaemonetes)

Starfish, brittle stars and sea cucumbers can be found in aquatic grass beds and on hard substrates. Sea anemones are usually attached to rocks, pilings or other hard surfaces.

Many invertebrates are native to North Carolina estuarine areas. Choose small, hardy specimens. Try to duplicate animals to simulate some communities found in brackish waters. Be conservation minded; don't collect in public areas or take more than you can use.

Feeding. Except for mullet (Mugil species) and the lyre goby (Evorthodus lyricus), which both prefer detritus, all other fishes will require supplemental feeding. Most invertebrates will subsist on detritus, but a number will benefit from additional foods. Detritus, decaying organic matter, is normally a food source for invertebrates, but rarely fishes. The value of detritus is in its coating of bacteria on the particles of decaying plant matter making up the material. The coastal zone animals consume the decaying plant material, but actually derive their nutrition from the adherent bacteria.

Three categories of supplementary foods are used in the brackish aquarium:

1. Live foods. Live brine shrimp may be hatched from eggs purchased at pet stores. Instructions for hatching are given on the containers. Live brine shrimp are eaten by fishes, worms, small anemones and bivalves. They are essential for raising young of several kinds of fishes. Adult brine shrimp may be purchased at some pet stores, but are expensive and not necessary. Adults are useful for those fishes which search out and prefer living foods, such as seahorses, pipefish and hogchokers. An alternative live food for baby fish are the minute nematodes known as "micro-worms." Cultures may be purchased from pet stores and are easily maintained.

2. Dried foods. Several forms of dried, prepared foods are sold at pet stores. Especially nutritious are the various preparations of krill or Euphausid shrimp, sold as ocean plankton, krill or simply plankton. Look for the name Euphausid shrimp on the label and avoid the large species such as Euphausia superba.

Of almost equal value are the flake food preparations. Some of the better brands include Kordon, Hill, Wardley and Longlife. Avoid cheap preparations and always compare ingredients. The best foods are the ones which include mosquito larvae and calanoid shrimp with lesser contributions of cereals. Freeze-dried foods should be avoided, as should specialty items containing either a single ingredient (except for krill, which are highly nutritious) or prepared for a special group of fishes (herbivores only).

3. Fresh foods. The inhabitants will greatly appreciate bits of shrimp, crab or fish, chopped earthworms or bits of seaworms. Cooked foods should not be given, and fresh foods should be rinsed under a running cold tap to wash away excess fluids before placing them in the aquarium. Experience is the only reliable guide to feeding, but always avoid leaving excess food in the aquarium.

Sick shellfish. A sick shellfish is seldom noticed. Only after death is the problem apparent. In the case of shrimp and small crabs, the dead animal is readily observed (do not confuse death with a moulted and shed shell casting) and can be removed or allowed to remain as food for the other creatures. Bivalves, however, tend to remain cryptic and death may not be seen (or smelled) until days after the event. This risks fouling the aquarium. For this reason, in addition to their need for particulate food in the water column, bivalves are usually not recommended for the brackish aquarium.

Sick fish. A fish that does not eat will quickly display symptoms of illness. These may be clamped fins, shimmying, hanging in a corner at a sharp angle, hiding, washed-out coloration, white spots over the body and fins, fuzzy growths anywhere on the body, popping eyes or bleached areas on the body or reddish patches on the body or fins. While many medications are on the market, few of them are of any value even in the early stages of disease. The best course is to dispose of any sick fish when the students are absent. Under no circumstances should a sick fish be feed to another fish.

Sick tank. The entire aquarium can become unbalanced, causing all the inhabitants to become stressed. Many stressed fish and invertebrates will die with no advance signs of disease, while others will tolerate very stressful conditions for a long time before slowly succumbing.

SIGNS OF A SICK TANK

- acrid odor to the water
- strong growth of shiny, dark-colored algae (shiny color characteristic of blue-green algae).
- gray coloration to the water
- fuzzy growths on the bottom
- fish not eating
- shellfish not moving about
- fish not reacting to stimuli
- sudden death of all members of one kind of animal

Check the following: pH, temperature, water level, dead bodies lodged in the decorations, filter clogged or running slowly, aquarium too crowded, new inhabitants added recently (introducing disease), overfeeding and last water change date.



Dr. Robert J. Goldstein
Consultant
Applied Biology Incorporated

SECTION TWO

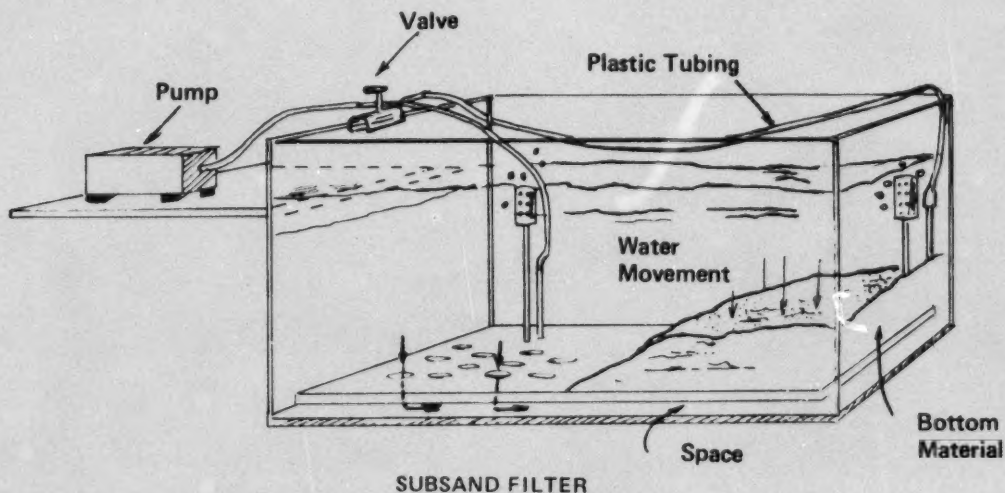
THE MARINE AQUARIUM

A marine aquarium takes more money, care and patience than a brackish aquarium system. However, you can teach about the sea from a classroom setting by having a marine aquarium. Living marine animals are fascinating to watch and they constantly demonstrate behavior and biological relationships. Then, the water in which sea animals live adjusts to environmental pressures. Many of the changes in sea water can be measured: salinity, pH, nitrate and phosphate, dissolved oxygen and temperature. Monitoring an aquarium is an interesting investigation in itself.

Setting up a marine aquarium requires an initial expense (or donation), care in its placement (not too close to the radiator, door, window) and regular maintenance once established. Students are usually interested in working with aquaria and can provide most of the maintenance and monitoring help. Your aquarium should be at least a 20-gallon tank. Some suggestions to aid and encourage you are given below.

a. Prepare the tank: Obtain an all-glass aquarium without a metal frame. Most marine organisms need a lot of water so be sure the aquarium will be big enough for your purposes. The usual size is between 10 and 30 gallons. Wash the aquarium with tap water and then rinse it with sea water.

b. Install the filter: Place an undergravel filter inside the aquarium and/or attach a pump-circulating filter to the outside of the aquarium. The more water circulation you can provide the better. If you are using a box or outside filter, then you should also install an air stone to provide additional aeration.



c. Add gravel substrate: Obtain a quantity of calcareous gravel about 5 mm ($\frac{1}{4}$ " in diameter to buffer the pH of sea water and filter water). Crushed oyster shell can be bought from a feed/hardware store. If you are using an undergravel filter, the gravel will be placed on top of the filter and must not be small enough to fall through the openings in the filter. Enough gravel is needed to make a layer 5-7 cm (2"-3") deep on the bottom of the aquarium. Rinse the gravel before using to remove any debris. Do not put any object into the tank that is made of metal.

d. Fill the tank with water: Obtain a supply of artificial sea water, e.g., "Instant Ocean." Very clean, settled sea water can be collected offshore or during a flood tide at an inlet, then held in the dark for 3 weeks. Place a pan or piece of paper on top of the sand in the aquarium to prevent the sand from being disturbed when the water is poured in. Fill the aquarium until the water level is about 2-3 cm (one inch) from the top of the tank. With magic marker, wax crayon or tape, mark the outside of the tank at the water level in order to check evaporation.

e. Install a glass cover and an aquarium light (optional): A glass cover will reduce water loss from evaporation and light will help you to see into the tank. The glass cover also prevents accidental trash (coins, gum, etc.) from being dropped into the tank.

f. To culture the filter, several methods are available; however, one of the surest is to obtain about a cup of gravel from a healthy marine aquarium that has been running for several months. Spread this "dirty" gravel over the gravel in your aquarium to inoculate it with beneficial bacteria. The bacteria are essential to the success of the aquarium. They utilize the waste products given off by the aquarium animals that if not removed would poison the animals. Add a few hardy animals such as crabs, lobster, groupers or sea bass to the aquarium so that as they are fed they will provide the filter with waste material to get it going. Do not feed them any more than what they will eat and remove any uneaten food. After about three weeks you should be able to begin replacing the hardy animals with more delicate species, but do not overcrowd the tank.

g. Avoid sharp changes in temperature, food or water. Remove about $\frac{1}{3}$ of the water every six weeks, and add new sea water. Replace any water lost by evaporation (indicated by the water level sinking below the line you placed on tank in step (d)) with fresh water.

h. Choose animals which are hardy and have good survival records in a classroom situation. These can be ordered from several biological supply companies or brought back from a beach trip (in aerated, cool jars).

1. Marsh minnows - mummichog, killifish and sheepshead minnow.
2. Small flounder, eels, rock bass or toadfish.
3. Starfish, sea anemones and sea cucumbers are usually very hardy.

4. Very small crabs (hermit, blue, mud) are useful to clean up scraps. Too large or too many crabs will destroy all the other life.
5. Most small snails do well. (Remember the "marsh periwinkle" - Littorina - breathes air.) Bivalves like clams, mussels, or oysters live reasonably well for short periods. Barnacles are an added bonus if you find some on oyster shells.
6. Avoid seaweeds, algae, and sponges in the tank as they don't survive and easily foul a tank.

i. Maintenance:

Daily

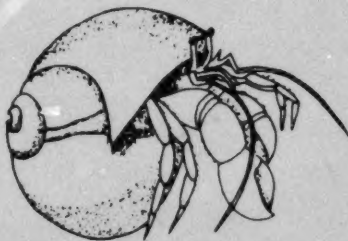
1. Check airlifts to ensure maximum water flow.
2. Make sure any accessories are operating correctly (heater, outside filter, light, etc.).
3. Check for any sick or dead fish.
4. When feeding, watch to see that most of the food is eaten.

Weekly

1. Check salinity and add fresh water to maintain initial water level.
2. Remove any salt accumulations on aquaria or accessories.

Monthly

Lightly stir gravel to stir up excess detritus, and siphon out $\frac{1}{4}$ of the sea water. Replace with aged natural or freshly mixed artificial sea water of the same salinity and temperature as the water removed.



*Hermit Crab
(Pagurus)*

SECTION THREE

A TOUCH TANK FOR THE CLASSROOM

A marine touch tank can enrich science in any classroom or volunteer program. Most students find living marine organisms exciting to observe and rewarding to care for. The touch tank provides students a field trip to the coast without leaving the classroom. Some suggestions on how to use the touch tank are listed below:

1. To show biological relationships.
2. To demonstrate animal behavior.
3. To enhance observational skills of students.
4. To allow students to investigate these marine organisms.
5. To teach responsibility and cooperation through the care of the animals/tank.
6. To provide a "hands on" experience in which all students can participate.
7. To stimulate interest in science and motivate students to become active learners.

Setting up a classroom touch tank can be a learning experience for teacher and student from start to finish. Students should be actively involved in the building, operating and maintaining process.

Designing a Touch Tank

The Box: The touch tank is simply a long, narrow box that holds water 4-6 inches deep. The overall depth of the container is suggested to be 12 inches at the minimum. This will allow 1-2 inches of gravel and about 4 inches of clearance above the water level. The box may be constructed of wood, plastic, or fiberglass. If wood is used to frame the box, its interior should be covered with plastic or fiberglass. (The latter is recommended.) The walls and ends of this container should be bound securely, since they will be subjected to extreme pressure.

Place: The entire box may be placed on a sturdy bench or a reinforced table. The height of the touch tank should be about waist high to the students. The bench may be designed with a shelf on one end to support the filter and electric power source. Caution--no electrical connections should be within 6 inches from the floor to meet electrical safety codes.

The Filter: A filtering system is necessary to mechanically clean water of particulates and also to chemically remove ammonia wastes from the animals. Either a siphon or an overflow tube must supply water to the top of the filter from the tank. (See diagram.) This filter can be a small 20-gallon tank. The filter system has the following for a 100-gallon touch tank:

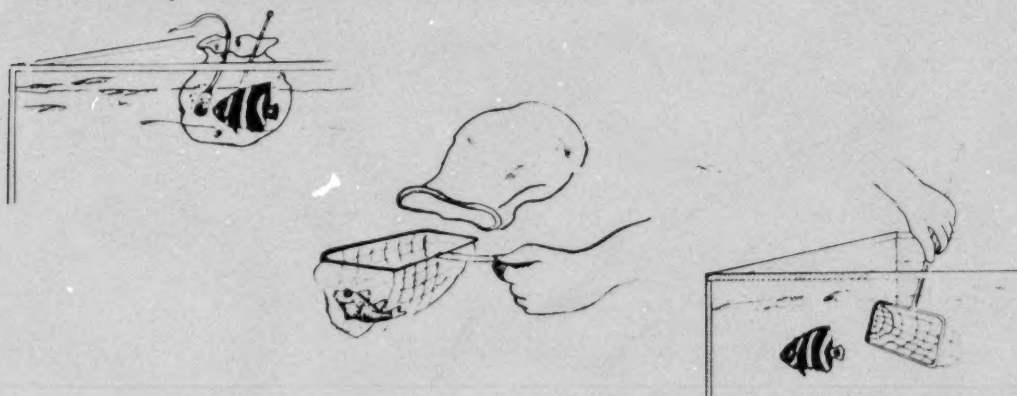
1. A piece of 1½" diameter PVC tubing should be cut into small cylinders that are 2-3 inches high. These cylinders are to be arranged (on end) in a pattern on the bottom of the small aquarium tank.
2. A piece of fiber screen, that has the same dimensions as the aquarium bottom, should be placed across the ends of these cylinders.
3. One or two inches of activated charcoal goes on top of this screen.
4. Next, 2-3 inches of floss should cover the charcoal. This may be held in place with medium-sized rocks.

Pump: The pump is the most expensive piece of equipment. Any one of several types may be used. For the larger systems, the higher flow-rate pumps are necessary. A tube should carry water from the bottom of the filter, through the pump, and back into the touch tank (opposite from the outflow end). The flow rate of the pump may be adjusted or additional siphons may be added to regulate the water flow. One might consult a scientific, pet or plumbing supply house for additional information concerning pumps. The system may be turned off at night to prevent mishaps. Overflow systems are safer than siphons which may empty the tank of the water pump fails or electricity is turned off.

Usually transportation of great quantities of saltwater is costly and messy. Artificial sea salt, e.g., "Rila" or "Instant Ocean," is excellent. Salt concentrations should approximate those of the estuarine waters from which the live specimens were obtained. An aquarium care booklet may be consulted to insure proper care of the system and its inhabitants.

Transporting Animals: You may want to collect animals for your aquarium on a trip to the coast. Transportation of animals is usually best accomplished in styrofoam coolers which are half filled with water. The water should be aerated with a portable aerator (available at bait shops and aquarium stores). Keep the water cool by placing small quantities of ice in plastic bags, tying the bags shut and floating them in your container. WARNING! Gather only enough animals to cover the bottom of the transporting cooler. Overcrowding will cause your animals to die as oxygen is depleted in the water.

Upon return home, place individual animals in plastic bags containing seawater from the cooler. Place the bag into the touch tank. When the water in the bag has had time to equilibrate to the temperature in the tank, release the animal to its new home.



Many different species of marine animals may be kept in the touch tank (check manuals for feeding instructions). Sea urchins do best when rocks can be taken from their natural habitat and placed in the tank. These rocks should be changed periodically and returned to their original location. Filter-feeders, such as scallops and oysters, make good program animals, but rotate specimens frequently. Filter feeders also provide food for many other individuals in the system, e.g., starfish.

The following is a short list of possible residents for your touch tank:

- Starfish and brittle stars
- Small crabs - hermit, blue, mud, spider
- Snails - periwinkle, moon snail, tulip
- Sea urchins, sand dollars, sea cucumbers
- Horseshoe crab
- Whelks
- *Mollusks - scallops, clams, oysters
- Blue crabs - rubber-band the claws for programs to prevent painful pinches.

*Caution should be exerted in using such critters for extended periods. It is recommended that a stock of mollusks be kept in a separate aquarium so that they may be alternated. AVOID seaweeds, algae and sponges.



Manley Midgett
Marine Science Educator
North Carolina State University
Science Education

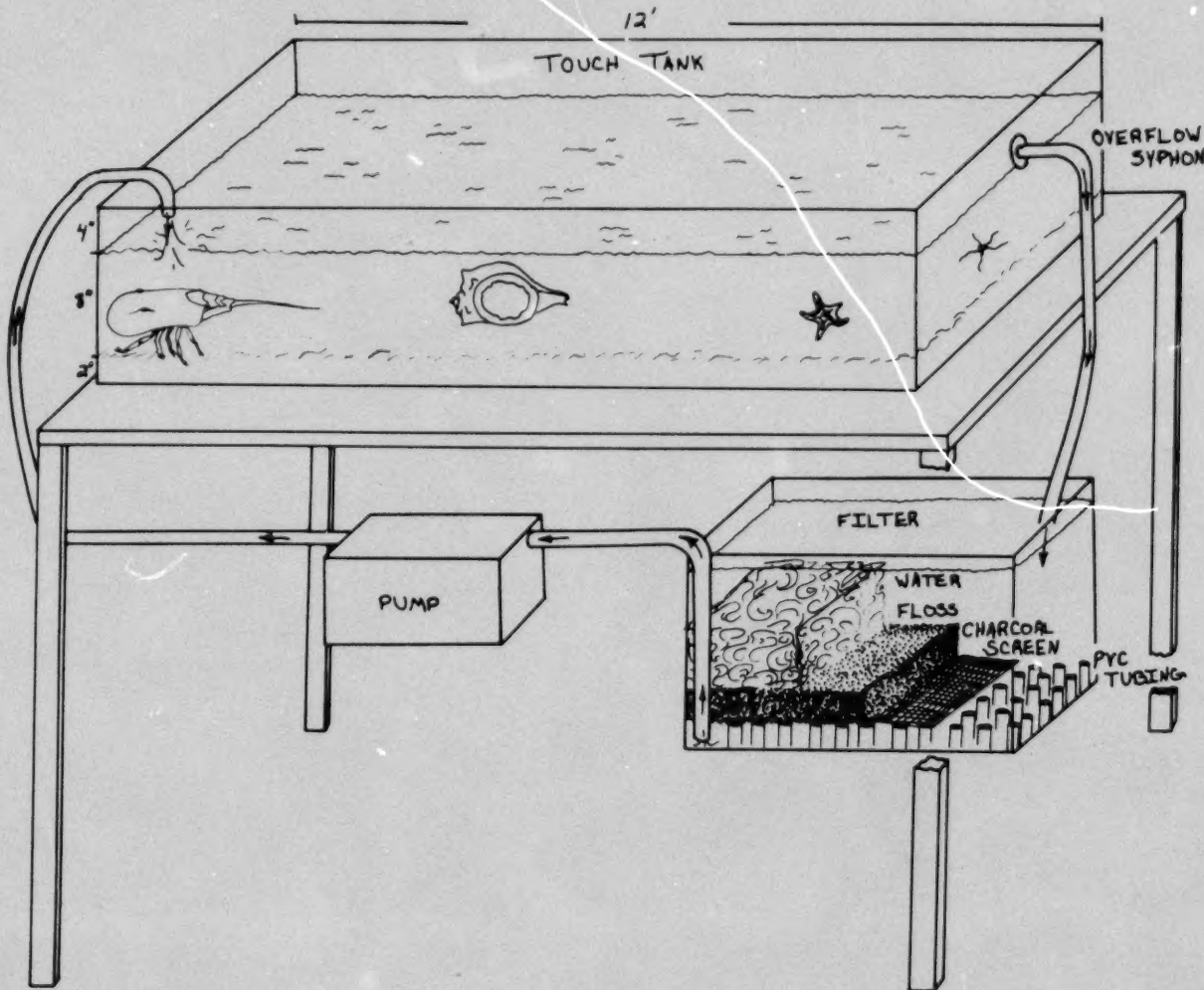
Mike Tally
Biology Educator
North Carolina State University
Science Education

TOUCH TANK MATERIALS LIST

- | | |
|-------------------------------------|---------------------------------------|
| 8 feet plastic pipe - 1½ to 2" | 6 feet tubing |
| 2 feet by 4 feet plastic mesh 1/16" | 1 Y fitting for air line |
| 1 20 to 30 gallon aquarium | 2 air stones |
| 25 to 50 pounds activated charcoal | several rocks |
| 1 large bag floss | 4 buckets gravel |
| 1 water pump | 100 gallons saltwater (Instant Ocean) |
| 20-foot water hose | *1 tank 3½' by 12' by 8' |
| 1 air pump | |

*Our tank was a transport compartment taken from a helicopter. It was bought at Federal Surplus for \$10.00. A similar tank could be constructed from a wooden frame lined with heavy-duty plastic. A more expensive model could be formed by fiberglassing a wooden frame.

CAUTION: Siphon should be adjusted so that it will cut off before the filter could overflow. A back-up valve may be inserted in the hose between the filter and the pump or between the pump and the tank. This will prevent back siphoning in the event that the pump ceases to function properly. You need a valve that will only let water go one way.



References

Morholt, Evelyn; Paul F. Bradwein; and Joseph A. Alexander.
Sourcebook for the Biological Sciences, (2nd Ed.). New York:
Harcourt, Brace and World, Inc., 1966.

Living Organisms for the Classroom. Division of Science, State Department of Public Instruction, Room 284, Education Building,
Raleigh, NC 27611.

SECTION FOUR

WHAT TO DO WITH YOUR TANK

A lot of learning and discussion takes place in setting up a living system, whether it is a saltwater aquarium, brackish aquarium or touch tank. Buying the components, washing the substrate, mixing up the correct salinity of the water and choosing animals involve much decision making. Why is oyster shell a good substrate? How do air pumps work? What is the purpose of a filter? What is the function of the thermometer and hydrometer? These are questions important for all age groups and all types of educational settings.

Once the aquarium system has been established, students will make exciting discoveries on their own. Encourage each student to keep a log book of their observations.

Most projects will fall into three groups: chemistry of the aquarium water; observations of specific animals; observations of interaction among the animals.

A. Chemistry

1. Using hydrometer, possibly homemade, to measure specific gravity and thus determine salinity. Maintaining proper salinity with freshwater dilution. Measuring evaporation in the tanks based on different temperatures of the room (this should not be manipulated for the health of the animal).
2. Using chemical kits (LaMotte or HACH), follow the ammonia, nitrite, nitrate cycle and nitrate levels of the aquarium. Keep a graph.
3. Take scraping off the sides of the aquarium and observe microscopic life. The type of diversity of microscopic protozoans, algae and animals changes with the maturity of the tank.

B. Specific Animals Observations

1. Use a structured format. Time observations and record animals behavior for two-minute intervals. This includes methods of movement, breathing, eating habits, location in the tanks and any defense or aggressive behavior. In some cases, you might want to move the animals to observation one-gallon tanks for short periods of time.

2. Observe adaptations and design of the animal. How is its survival enhanced by its body shape? Where would this animal live in nature? How is it adapted for that particular environment and associations with other organisms?
3. Certain hardy animals, e.g., hermit crabs and snails, can be used in manipulations. For example, races between two hermit crabs, pulling power of snails (glue a string to its shell with a paper clip attached), make a maze with two shoe boxes and plastic garbage bags. The animal is put in the long part of the "T." A tiny bit of food is placed in one half of the "T" crossing. How long does it take for the animal to smell the food? How long to move to it? Make a more complicated maze. Can you train a crab like scientists do rats? Using a clear-bottomed glass or plastic tank/tray, color preferences can be determined. Put pieces of colored construction paper under the tray. Start with dark and light. Do the animals show preferences? Test the preference of the animal to move toward or away from light. (Brine shrimp, grass shrimp, minnows and crabs respond well.)

C. Interactions Among Animals

1. Using the time-interval observation technique, record the behavior between two animals. You have better results during feeding periods. Crabs are usually actively aggressive and dominate group interactions. Starfish may eat a mussel, and fish may create and defend territories. These are examples of interactive behavior.

For additional sources of information on how to use your aquarium or touch tank, check these references:

Philip, Raleigh T. 1976. Jewel Marine Aquarium Laboratory Manual. Jewel Industries, Inc., 5005 West Armitage, Chicago, IL. 60639.

Gordon, Cynthia. Salt Water Aquarium. Center for Collaborative Learning Media Packages, Wellesley Public Schools, Wellesley, MA.



Toadfish

SECTION FIVE

SOURCES OF INFORMATION ABOUT KEEPING A BRACKISH OR SALTWATER AQUARIUM

Carolina Marine Aquaria. \$1.00. Carolina Biological Supply Company,
Burlington, NC 27215.

Dames, D. E. 1972. Carolina Tips, Vol. 35. Free pamphlets. #1
Try a Marine Aquarium. #2 Maintaining the Marine Aquarium.
#9 Chemistry in the Marine Aquarium. Carolina Biological Supply
Company.

Geisler, Rolf. Aquarium Fish Diseases. Neptune City, NJ. T.F.H. Pub-
lications, 1963. 48 pp.

Gilbert, Miriam. Science-Hobby Book of Aquariums. Lerner Publications
Company, 1973, c 1968. 45 pp.

Graaf, Frank de. Marine Aquarium Guide. Harrison, NJ. Pet Library
(1973) 284 pp.

Kubler, Rolf. Light in the Aquarium. Neptune City, NJ. T.F.H. Publi-
cations, 1973. 96 pp.

Marine Aquaria. Project Coast Packet #3. University of Delaware,
Newark, DE 19711.

Project CAPE. How to Set Up a Saltwater Aquarium. \$1.00. Project CAPE,
Box 640, Manteo, NC 27954.

Reef and Shore: "Hawaii Nature Study Program." 1976. Curriculum Research
and Development Group. University of Hawaii, 1776 University Avenue,
Honolulu, HI 96822. (Excellent guide for maintaining and using
aquaria and simple experiments with marine animals.)

Simon, Seymour. Tropical Saltwater Aquariums: how to set them up and
keep them going. 1st edition. New York: Viking Press, 1976. 90 pp.

Spotte, Stephen H. Fish and Invertebrate Culture; Water Management in
Closed Systems. New York, Wiley - Interscience, 1970. 145 pp.

Spotte, Stephen H. Marine Aquarium Keeping. New York: John Wiley and
Sons, 1973.

Stevenson, Robert A., Jr. The Complete Book of Saltwater Aquariums.
New York: Funk and Wagnalls, 1976.

- Straughn, Robert P. L. Keeping Live Corals and Invertebrates. South Brunswick, 1975. 228 pp.
- Straughan, Robert P. L. (2nd revised edition.) The Salt-Water Aquarium in the Home. New York: A. S. Barnes and Co., 1969.
- Straughan, Robert P. L. Adventures in Marine Collecting. South Brunswick, A. S. Barnes, 1973.
- Valenti, Robert J. The Salt-Water Aquarium Manual. New York: Aquarium Stock Co., 1968.
- Wainwright, Neil. Coldwater Aquariums and Simple Outdoor Pools. London, New York, F. Warne, 1972. c 1969. 81 pp.
- Wachtel, Hellmuth. Aquarium Ecology. Neptune City, NJ. T.F.H. Publications, 1973. 128 pp.
- Waters, Barbara. 1973. A Closed Salt-Water System. \$.50. Northeast Marine Specimens Co., Inc., P. O. Box 1, Woods Hole, MA 02543.
- Waters, Barbara. Ocean In Your Classroom, Part I - IV. Cape Cod Extension Office, Railroad Avenue, Barnstable, MA 02630.
- Weigel, Wilfried. Aquarium Decorating and Planning. Neptune City, NJ T.F.H. Publications, 1973.

Source for Marine Animals: Carolina Biological Supply Company
Burlington, NC 27215

Gulf Specimen Co., Inc.
P. O. Box 237
Panacea, FL 32346

Northeast Marine Specimen Co.
P. O. Box One
Woods Hole, MA 02543

Artificial Sea Water: Instant Ocean
Aquarium Systems, Inc.
33208 Lakeland Blvd.
Eastlake, OH 44094

Caroline Biological Supply Co.
Burlington, NC 27215

Chemical Testing Kits: HACH Chemical Kits
Ames, IA 50010

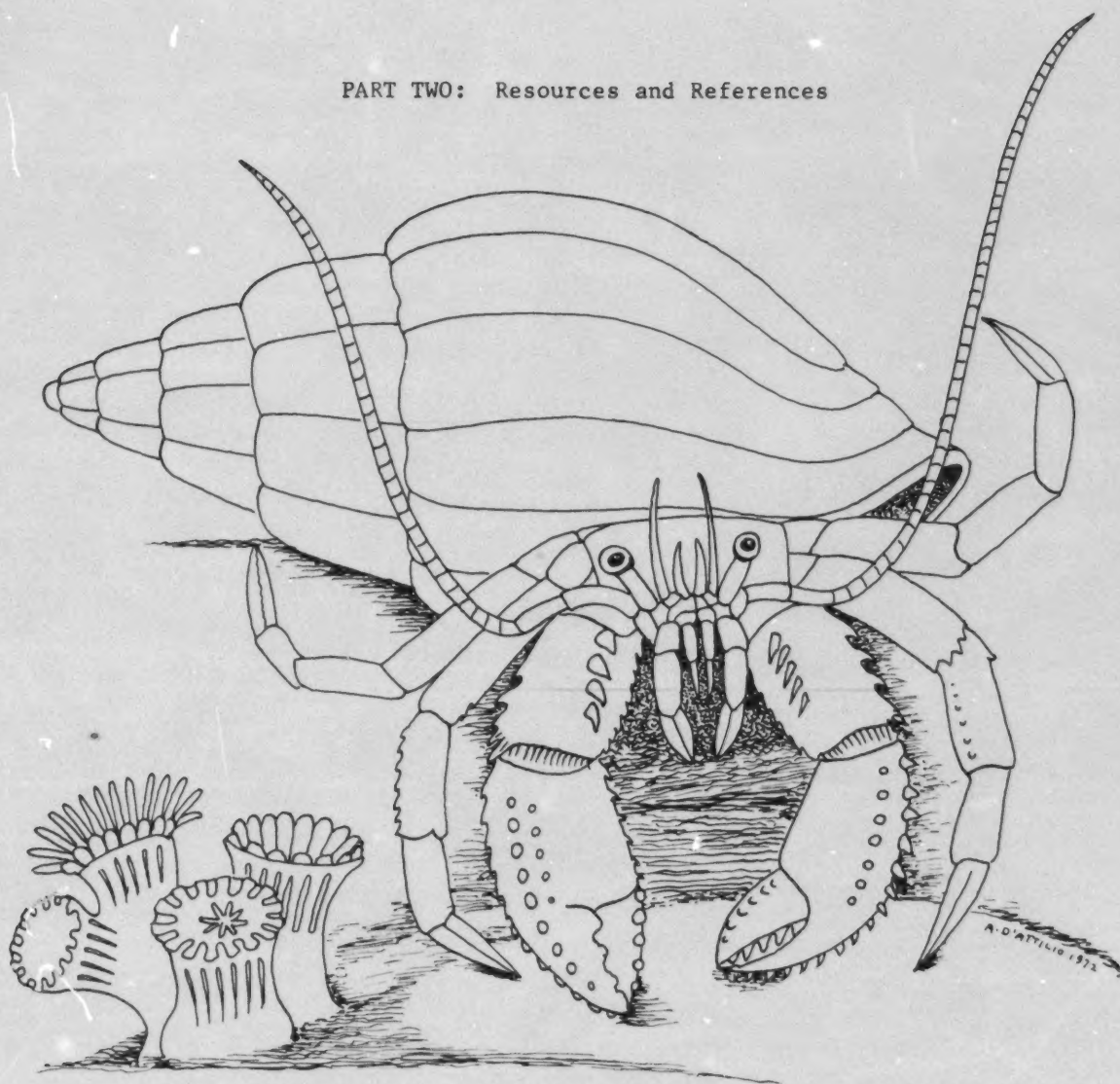
La Motte Chemical Products Co.
"Chemical Testing Equipment for the
Marine Aquarium"
Chestertown, MD 21620

Aquarium Filters and Pumps: "Silent Giant" pumps sufficient pressure for two 20-gallon tanks or a series of gallon jars.

"Dynaflow" filter sits outside tank.

"Biosurge" undergravel filter by Nektonics.

PART TWO: Resources and References



1. Going to Sea: Focus on Marine Education
2. UNC Sea Grant College Program
3. North Carolina 4-H Program
4. Weather Awareness Education
5. Organizations
6. Bulletins, Journals and Magazines
7. Film Companies
8. North Carolina Films
9. N.C. State Government Resources
10. Federal Government Resources
11. Marine Careers Resources

C 1973 Dover Publications, Inc., NY. Seashore Life Coloring Book,
Illustrations by Anthony D'Attilio.

SECTION ONE

GOING TO SEA: FOCUS ON MARINE EDUCATION

When environmental educators go to sea, we "marinate" traditional land-oriented subjects and highlight special aspects of the coast and ocean. Educators are becoming increasingly aware that we live in a watery world which is demanding our concern and offers us a richness of the past and hope for the future. From a small cadre of educators in the 1960s who focused their disciplines on the sea or freshwater bodies, the number of people, the amount of interest, public exposure and financial support have increased tremendously. Marine education emphasizes the inclusion of that part of the natural environment which comprises 71 percent of the earth's surface and much of our national culture and history.

What is Marine Education?

The initial definition of marine education is stated in the Sea Grant publication by Goodwin and Schaadt: "Marine and aquatic education is that part of the total educational process which enables people to develop a sensitivity to and a general understanding of the role of the seas and fresh water in human affairs and the impact of society on the marine and aquatic environments. Marine and aquatic education is a part of environmental education."¹

Two simple and relatively unconnected statements form the basis for marine education. First, people pressure is putting unhealthy stress on the coast. Multifaceted use of coastal real estate for residents, industry, recreation, waste disposal, transportation and agriculture often conflicts with the natural systems' ability to maintain an ecological balance. Critical issues in coastal management and utilization of natural resources expose problems and the subsequent lack of means to answer them. The public needs to be aware of issues which span politics, human need and ecology. People have to be trained to research these problems. Marine- and water-related topics have not been given educational time commensurate with the importance of the issues.

Secondly, marine education encompasses themes and ideas which motivate students. The aura of mystery and adventure combined with curiosity of

¹H. L. Goodwin and J. G. Schaadt, 1978, "A Statement on the Need for Marine and Aquatic Education." Delaware Sea Grant College Program, College of Marine Studies, Newark, DE 19711.

strange creatures continues to excite students of all ages and abilities. Jim Lanier says: "It's time to press the argument that marine education for young students is not a frill but an invaluable aid for teaching the basics."²

In addition, two recent articles further define marine education: Fortner and Wildman, "Marine Education: Progress and Promise" in Science Education (64 n.5, 1980) and Picker, "Our Water Planet, Learning About the Sea" in Oceans (S-O, 13 n.5, 1980). Picker's article is particularly useful in emphasizing the interdisciplinary focus of marine education. The October 1980 issue of Science and Children (18 n.2) was devoted to marine education. The fourteen articles outline major thrusts within the field.

Marine education also funnels through informal education routines, e.g., aquaria and museums, and resource/nature centers. These facilities have exhibits, programs and staff trained in interpretation. The focus is typically natural and maritime history.

Three Strategies

Marine education is also becoming integrated into formal education systems. Three strategies have emerged: the development of distinct marine courses, the use of specific time-slots for marine issues, and the use of infusion.

Initial efforts of marine educators came from science. Coastal and urban schools incorporated specific courses on marine science and marine biology. One of the earliest successful curricula was The Marine Science Project of the Carteret County Schools, Beaufort, North Carolina directed by Will Hon, funded by the Environmental Science Education Act (ESEA) Title III, 1968-71. Publications from this project are suitable for kindergarten through tenth grade. Although out of print, it can be reviewed using microfiche. (Refer to Section on MEMS.)

University of Hawaii Curriculum Research and Development Group produced two curricula. Coastal Problems and Resources Management (1979)³ is a one-semester course for secondary school students. The course focuses on the coastal region of the United States and the political, economic and ecological factors involved in the development of coastal resources. It was funded by the U.S. Office of Coastal Zone Management and Hawaii Coastal Zone Management Program. It is billed as a social studies course, but works well as an environmental education course. The second Hawaiian course is the one-year secondary marine science curriculum, High School Marine Science Studies

²J.A. Lanier, 1980. "Marine Education: A Message in a Bottle." Science and Children, Oct., vol. 18, no. 2.

³R.L. Mitchell. Coastal Problems and Resource Management. Curriculum Research and Development Group. University of Hawaii at Manoa, 1776 University Avenue, Honolulu, HI 96822.

(1980)⁴. Its goals include awareness, appreciation, and commitment to the wise use of the oceans and all other environments. Both curricula have national distribution and in-service programs.

To use a specific time-slot, teachers choose a particular week or day to focus on a marine theme. Vivian McLean teaches educable mentally-retarded students in Wake County, North Carolina. Each Monday is "Coast Day". She works math, reading and social skills with a maritime flavor. No "blue Monday" for these kids; they want Monday every day of the week. A variation of this is to take a marine topic, like whales, and apply basic skills to learn all about whales. The rationale is that most kids, be they in Maine, Mississippi or Kansas, like whales. The teacher is using a marine concept to motivate, enrich and assist learning in an interdisciplinary fashion.

Most marine educators favor integrating marine concepts and activities into basic curricula. This prevents adding on to an already crowded lesson plan. For example, using real charts of Florida and sites of wrecked Spanish galleons in a sunken treasure hunt combines geography and social studies in the study of early American history. Public access to the beaches is a controversial issue which would make a fine government class debate with students representing property owners, vacationers or county commissioners. Picker elaborates on the infusion model in his article "What is Marine Education?" (Science and Children, October, 1980.)

Several curricula projects listed below have been designed to provide teachers with marine concepts and activities which fit into the regular course of study. Most have regional orientation. Additional projects can be identified using the Marine Education Materials System (MEMS) described later in this article.

Project CAPE. P. O. Box 640, Manteo, NC 27954. Multi-disciplinary activities to stimulate learning about the marine environment. Primary and middle school units available. Write for more details.

Carolina Wetlands Project. 1033 Wade Avenue, Suite 207, Raleigh, NC 27605. (919) 832-2971. Educational materials available without charge include the film, "America's Wetlands" (16 mm, color, 28 minutes), a slide show and a variety of printed materials on wetlands values and preservations.

Project COAST. Sea Grant/University of Delaware. Series of over 125 topic-oriented packages covering various topics such as dune dances, marine stories and oysters. 1974. University of Delaware, 310 Willard Hall, Education Building, Newark, DE 19711.

Ocean Related Curriculum Activities (ORCA). Sea Grant/Pacific Science Center/Sea Grant, 200 2nd Avenue North, Seattle, WA 98109. Over eight volumes covering specific topics from navigation to Indians to beaches.

⁴E.H. Chave. 1980. High School Marine Science Studies. University of Hawaii, Curriculum Research and Development Group, 1776 University Avenue, Honolulu, HI 96822.

Northern New England Marine Education Project. 1979. Sea Grant/College of Education, University of Maine, Orono, ME 04469. Over fifteen volumes covering interdisciplinary topics like whales, art, aquaculture, ships and aquaria.

North Carolina Marine Education Project. UNC Sea Grant College Program, 105 1911 Building, NCSU, Raleigh, NC 27650. Five volumes covering specific topics like coastal geology and history.

Investigating the Marine Environment and Its Resources. V. Lien, 1979. Texas A & M Sea Grant University Program, College Station, TX 77843. Two volumes of interdisciplinary activity and information on the Gulf Coast.

Smithsonian Estuarine Activities (SEA). S.P. Gucinski, ed., 1979. Smithsonian Institution, P.O. Box 28, Edgewater, MD 21037. A series of activities investigating marshes and estuaries.

Wet, Wild and Deep, the Physical Ocean. Institute for Marine and Coastal Studies/Sea Grant, USC, University Park, Los Angeles, CA 90007.

The Source Book of Marine Science. S. Dobkin, ed., 1980. Florida Oceanographic Society, 1212 Riverside Drive, Stuart, FL 33494. Laboratory experiments of the oceans.

"Sensing the Sea." (Grades Two-Three) E. Odell-Fisher and R.N. Giese, 1978. Virginia Institute of Marine Science, Gloucester Point, VA 23062.

Children's Literature--Passage to the Sea. N. Bagnall, 1980. Sea Grant/Texas A & M, College Station, TX 77843.

Investigating the Marine Environment: A Sourcebook. H.M. Weiss and M.W. Dorsey, 1979. 3 vol. Project Oceanology, Avery Point, Groton, CT 06340.

Marine Organisms in Science Teaching. J.D. Hunt, ed.. Texas A & M College Program, College Station, TX 77843.

Information Exchange

Information transfer has been and continues to be a problem with environmental education projects. Good curricula go out of print, have limited circulation, or for what other reasons may exist, get into few classrooms. Marine education projects have the same problems. There are, however, a number of existing avenues for information exchange:

Educational Resource Information Center, Clearinghouse for Science, Mathematics and Environmental Education (ERIC/SMEAC). The Ohio State University, 1200 Chamber Road, Room 310, Columbus, OH 43212. A microfiche computerized collection of research and resource documents of use to educators at all levels. ERIC is located in most university libraries. Over 1500 documents have marine education significance.

Office of Sea Grant, NOAA. 6010 Executive Boulevard, Rockville, MD, 20852. The Maryland office can give you information concerning the nearest Sea Grant program and relevant Sea Grant supported educational projects. Sea Grant programs are located in thirty states; supported by federal/state funding, they promote the wise use of marine resources through research, education and advisory services.

State Marine Education Coordinator in your state Department of Education. Each Chief State School Officer has appointed an individual within his/her staff who can respond to inquiries.

National Marine Education Association, Virginia Institute of Marine Science Education Center, Gloucester Point, VA 23062. Inquiries can direct you to regional organizations and individuals who can provide assistance. NMEA publishes Current: Journal of Marine Education which carries a wide range of marine education articles.

Marine Education Materials System (MEMS). Microfiche computerized collection of marine education materials which is constantly being updated. The Virginia Institute of Marine Science (VIMS) with assistance from the National Sea Grant Program devised MEMS for the collection, storage, retrieval and dissemination of marine education materials.

MEMS contains information on curriculum, articles on marine topics, field and lab activities and many disciplines including science, language arts and social studies appropriate for primary, middle school and secondary grades plus higher education. All articles are reproduced onto microfiche, a type of microfilm, on which up to 60 pages of printed information are filmed on a 4 by 6 inch card. A microfiche reader is necessary to magnify the material. A microfiche printer provides paper copy of the material.

A computerized retrieval system classifies all articles by author, title, source of publication, subject and grade level. Thus, you, as a teacher, supervisor or resource person, can locate either specific articles known to you or research unknown articles which will provide information either by grade, topic or discipline.

MEMS is located in the following places:

Education and Information Center
(Contact Person: Ann Fowler)
North Carolina Department of Public Instruction
Education Building Room 581
Raleigh, NC 27611
(919) 733-7904

(Services: Microfiche reader and printer available in Room 581. E & I Center will search topics for you and reproduce articles free of charge on microfiche and print selected articles at 15¢ per page.)

North Carolina Marine Resource Center/Roanoke Island
Manteo, NC 27954
(919) 473-3493

(Services: Microfiche reader and printer available
in Library)

D. H. Hill Library
Microform Reading Room
North Carolina State University
Raleigh, NC 27650
(919) 737-3280

(Services: Microfiche reader available)

Virginia Institute of Marine Sciences--Sea Grant Program
(Contact Person: Sue Gammisch)
Gloucester Point, VA 23062
(804) 642-2111, Extension 111

(Services: Microfiche reader and printer available
if you visit facility.
Literature searches of MEMS collection
designed to meet your needs. \$5.00. Write
or telephone request.)

The Guide to the Marine Education Materials System,
instructions on how to use MEMS, plus thesaurus of
descriptors used to classify subjects. \$5.00.)

This article appeared first in Environmental Education Report. February 1981.



Lundie Spence
Marine Education Specialist
UNC Sea Grant College Program

SECTION TWO

UNC SEA GRANT COLLEGE PROGRAM



UNC Sea Grant College Program
105 1911 Building
N. C. State University
Raleigh, NC 27650

(919) 737-2454

The Sea Grant program is a unique blend of research, advisory services and education, one of 28 similar federal/state programs in the nation.

Working with faculty members on four campuses of the University of North Carolina and other scientists throughout the state, Sea Grant has access to a variety of talents and expertise. With funds provided yearly by the National Sea Grant office administered by NOAA, and state funds administered by the Office of Marine Affairs, research and education proposals are supported in the major categories of estuarine studies, coastal studies, food from the sea, and marine education.

Results of these studies are disseminated by the 12 advisory agents through workshops and direct day-to-day contact with people in the coastal area. Also, publications are continually being produced and widely distributed at little or no cost to the public. They are available upon request at the above address. For example, Sea Grant has supported studies which were concerned with shoreline protection, construction, hurricanes and safety, seafood marketing, channels, aquaculture, off-road vehicles, recreation, barrier island processes, estuarine pollution, new sources of protein and improved methods of seafood processing along with many other marine-related topics.

Sea Grant Publications Marine Education Materials

North Carolina Marine Education Manuals, by Lundie Mauldin, Dirk Frankenberg and Johanna Bazzolo, are designed to help educators present the coast as both a setting and subject study.

UNC-SG-78-14-A Unit One, Coastal Geology. 108 pages. Illustrated. \$1.00.

UNC-SG-78-14-B Unit Two, Seawater. 76 pages. Illustrated. \$1.50.

UNC-SG-78-14-C Unit Three, Coastal Ecology. 100 pages. Illustrated. \$1.50.

UNC-SG-78-14-E Unit Four, Coastal Beginnings. 175 pages. Illustrated. \$2.00.

UNC-SG-82-01-F Connections. Guide to Marine Resources, Living Marine Systems and Coastal Field Trips. Illustrated. \$2.00.

(North Carolina educators may receive a single copy of each manual free of charge. Prices listed cover out-of-state requests.)

UNC-SG-81-04 A Guide to Salt Marsh Plants Common to North Carolina, by Elizabeth Jean Wilson, is a teaching guide to the herbs, vines, grasses and shrubs found in North Carolina marshes. 32 pages. \$1.50.

UNC-SG-73-06 Seacoast Plants of the Carolinas for Conservation and Beautification, by Karl E. Graetz, is a handbook on use of plants for landscaping and stabilizing coastal soils. 206 pages. \$2.00.

UNC-SG-75-23 Don't Waste That Fish, by Dixie R. Berg, Theodore M. Miller and Frank B. Thomas explains how to dress, fillet, freeze, store and prepare fish. Illustrations and fish identification guide. Free.

UNC-SG-78-15 Storms, People and Property in Coastal North Carolina, by Simon Baker, recalls the destructive hurricanes and northeasters of the past and discusses safety precautions and prevention of property damage. 82 pages, illustrated. Free.

UNC-SG-72-09 Sea Shells Common to North Carolina, by Hugh J. Porter and Jim Tyler, is an illustrated guide to the state's shells. 36 pages. \$.75.

UNC-SG-79-02 Vacation and Weather Guide to Coastal North Carolina, illustrated with photos, maps and charts, provides weather and recreation information to help you plan your vacation. 28 pages. Free.

UNC-SG-78-13 Wreck Diving in North Carolina, by Dennis Regan and Virginia Worthington, describes 43 of the State's undersea shipwrecks and relates their locations and depths. Includes bibliography and a list of nearby decompression facilities. 16 pages. Illustrated. Free.

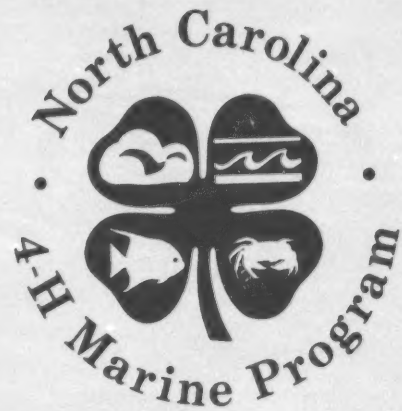
Rip Currents, an 11" x 28½" poster, explains what causes the dangerous currents, how to spot them, and what to do if you get caught in one. Free. No publication number.

Hurricanes on the Coast of North Carolina is a colorful 32½" x 23" poster that recalls some of the state's most destructive hurricanes. Poster also illustrates the composition of hurricanes and describes the destruction they cause. Free. No publication number.

SECTION THREE

NORTH CAROLINA 4-H PROGRAM

N.C. 4-H and Youth Development
P.O. Box 5157
N.C. State University
Raleigh, NC 27650



4-H, the youth program of the North Carolina Agricultural Extension Service, is a year-round educational program conducted on community, county, district and state levels for youths, ages 9-19 years. Leadership for the program is provided through a core of invaluable adult and teen volunteers, professional and paraprofessional staffs located in the 100 counties of the state, and a professional state-level staff based at North Carolina State University, Raleigh and A & T State University, Greensboro.

4-H is a varied program dedicated to the total growth and development of boys and girls of all races whether they live on the farm or in the city. During 1981, over 90,000 youths were involved in the North Carolina 4-H program. Wise consumerism, career exploration and production and management in the related fields of agriculture and home economics are a major part of the program. These and other programs, such as community action, environmental awareness, leisure education, fire and bike safety and horsemanship, point to the fact that 4-H is constantly striving to meet the changing needs of boys and girls.

4-H Marine Awareness Program

4-H Marine Awareness Project Materials are available from your county 4-H agent. Project materials designed for leaders and members include:

4-H Fishing Project
Fish Printing
Food Webs
Marine Photography
Pressing Algae

Saltwater Aquariums
Sampling Plankton
4-H Seafood Project
Transplanting Marsh Grass

Films, slide sets, videotapes, summer workshops for teenagers, and coastal camping are also a part of this new and exciting program in 4-H!

For more information concerning the 4-H Marine Awareness Program, contact your County Agricultural Extension Office or:

Jaynee Medlicott
State 4-H Office
202 Ricks Hall
North Carolina State University
Raleigh, North Carolina 27650
(919) 737-3243

SECTION FOUR

WEATHER AWARENESS EDUCATION

North Carolina's coastal weather is unique. Some days thick fog will settle over the Outer Banks while people in the midlands and mountains bask in bright sunshine. Sea breeze fronts will develop and move inland, carrying afternoon showers and thunderstorms to towns like Burgaw, Bayboro, Belhaven and Bellcross while the skies over the beaches are almost cloud-free. Occasionally, a hurricane will pass by and completely rearrange the shape of the barrier islands.

Introducing weather information to your school or community can be a relatively simple task--if you know where to look. The following lists will help you to find films or books for your weather awareness program.

TELEVISION

1. Every morning on Monday through Friday at 7:45 a.m., the UNC Center for Public Broadcasting televises an excellent program called "A.M. Weather." There are several ways that "A.M. Weather" can be brought into the classroom. These methods are discussed and learning modules are provided in an excellent publication, A.M. Weather For Teachers. This resource guide is available from the Government Printing Office for \$3.50 (stock number S/N 003-018-00104-7). To obtain a copy, write:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

2. The North Carolina Department of Public Instruction has developed an instructional television series called "What On Earth?" for eighth-grade earth science students. This series has nine programs which deal with weather. For more information on the series and the teacher's lesson guide, write:

Rita Graves
Division of Educational Media
Department of Public Instruction
Raleigh, NC 27611
(919) 733-3193

FILMS

1. The National Oceanic and Atmospheric Administration (NOAA) offers more than 50 films free of charge (except for return postage). Detailed information on these films can be found in an article by Edward Brotak

entitled "Audio-visuals about the weather" which was printed in the December 1981 issue of Weatherwise (pp. 268-272). A brochure can be obtained by contacting:

Motion Picture Service
Department of Commerce - NOAA
12231 Wilkins Avenue
Rockville, MD 20852
(301) 443-8411



2. The National AudioVisual Center serves as a clearinghouse for all federal audio-visual materials. Subjects range from energy and environmental studies to oceanography and meteorology. To obtain a catalogue and more information on the more than 10,000 items available from the clearinghouse, contact:

National AudioVisual Center
National Archives and Records Service
General Services Administration
Reference Section HH
Washington, DC 20409
(301) 763-1896

3. Information on weather films offered by the American Meteorological Society, National Science Foundation, Learning Corporation of America, National Center for Atmospheric Research and other organizations may be found in the August 1981 issue of the Bulletin of the American Meteorological Society (pp. 1215-1217). This information is updated, and each year new lists appear in the August issue.

4. In 1978, a guide on films on natural hazards was prepared. The Directory of Sources for Films and Other Visual Materials on Natural Hazards and Their Mitigation is available from:

Natural Hazards Research
and Applications Information Center
Institute of Behavioral Science
University of Colorado
Boulder, CO 80309
(303) 492-6818

BOOKS AND PUBLICATIONS

1. In the 1960s, the National Science Foundation provided funding for the development of a paperback series for secondary-school students and weather enthusiasts. The books, listed below, may be ordered through local bookstores or directly from:

Doubleday Anchor Books
Garden City
Long Island, NY 11530

The Edge of Space (Richard A. Craig, 1968)
From Raindrops to Volcanoes (Duncan C. Blanchard, 1967)
Harvesting the Clouds (Louis J. Battan, 1969)
Jet Streams (Elmar Reiter, 1967)
The Unclean Sky (Louis J. Battan, 1966)
Watching for the Wind (James G. Edinger, 1967)
Weather and Health (Helmut Landsberg, 1969)
Weather on the Planets (George Ohring, 1955)

2. There are several government publications which document climatic variations, discuss our weather history and provide information on clouds, thunderstorms, tornadoes and hurricanes. A comprehensive list may be found in the October 1981 issue of Weatherwise (pp. 218-220).

3. Each year the American Meteorological Society lists recent publications in the May issue of the Bulletin. Most of the books are technical in nature, but there are always a few listed which should be of interest to the enthusiast and the educator.

4. The bimonthly publication, Weatherwise, is produced by the Helen Dwight Reid Educational Foundation. This is an excellent source for feature articles and reviews of recent weather conditions in the United States. The annual subscription rate is \$22.00 for institutions and \$15.00 for individuals. The address is:

Weatherwise
 4000 Albemarle Street, NW
 Washington, DC 20016

5. Here is a brief list of books that will enhance your weather projects and experiments.

****Allen, E. S., 1976: A Wind To Shake The World - The Story of the 1938 Hurricane. Little, Brown and Company, Boston, MA. 370 pp.

**Battan, L. J., 1961: The Nature of Violent Storms. Doubleday and Company, Garden City, NY. 158 pp.

Legend

- **** - Outstanding, highly recommended for all students.
- *** - Very good, recommended for the curious students.
- ** - Good material but too complex for the slower students.
- * - Good material but too complex for the slower students.
- Ref - Reference material only.

Ref - Ruffner, J. A., and F. E. Blair, 1977: The Weather Almanac. Avon, NY. 728 pp.

**Watts, A., 1968: Instant Weather Forecasting. Dodd, Mead and Company, NY. 64 pp.

***Ludlum, D. M., 1963: Early American Hurricanes, 1492-1870. American Meteorological Society, Boston. 198 pp.

Ref - Neumann, C. J., G. W. Cry, E. L. Caso, and B. R. Janivan, 1978: Tropical Cyclones of the North Atlantic Ocean, 1871-1977. National Climatic Center, Asheville, NC. 170 pp. (For sale by the Supt. of Government Documents, USGPO, Washington, DC 20402. Stock #003-017-00425-2.)

**Tricker, R. A. R., 1970: The Science of the Clouds. American Elsevier Publishing Company, Inc., NY. 144 pp.

***Trowbridge, L. W., 1973: Experiments in Meteorology - A Book of Investigations for the Amateur Scientist. Doubleday and Company, Inc., Garden City, NY. 270 pp.

DISPLAYS AND EXHIBITS

An outstanding exhibit was recently developed by the University of Oklahoma. An article entitled "An interactive weather exhibit at OMNIPLEX," which is in the August 1981 issue, Bulletin of the American Meteorological Society (pp. 1219-1223)

INSTRUMENTS

Information on small instruments, such as the sling psychrometer or hand-held anemometers, can be obtained from the following companies:

Science Associates
230 Nassau Street
Box 230
Princeton, NJ 08540

WEATHERtronics
2777 Del Monte Street
West Sacramento, CA 95691

Weather Measure
P. O. Box 41257
Sacramento, CA 95841

John F. Sanders
Coastal Weather
Awareness Specialist
UNC Sea Grant College Program

SECTION FIVE

ORGANIZATIONS

Members of the following organizations are interested in various aspects of our state's natural resources. You may want to consider these people for possible lectures, workshops or special programs. They have quite a bit of fascinating information to share!

N.C. Audubon Council
Patsy Govert
P.O. Box 2693
Chapel Hill, NC 27514

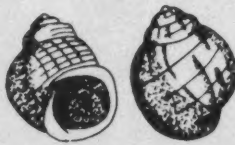
N.C. B.A.S.S. Federation
Morris Allen
2135 Belmont Street
Burlington, NC 27215
(919) 228-8937

N.C. Nature Conservancy
Thomas W. Reese
P.O. Box 69
Hickory, NC 28601
(704) 324-7135

N.C. Seashell Club
Charlotte Dexter
Rt. 1, Box 648
Wilmington, NC 28405
(919) 686-9187

N.C. Trout Unlimited
Don Holbrooks
99 Farm St.
Asheville, NC 28806
(704) 253-3341

North Carolina Wildlife Federation
P.O. Box 10626
Raleigh, NC 27605
(919) 832-2971



SECTION SIX

BULLETINS, JOURNALS AND MAGAZINES

Aquanotes (Free)

Louisiana State University
Sea Grant
Baton Rouge, LA 70803

Audubon Magazine

Membership Department
950 Third Avenue
New York, NY 10022
\$13.00 (Bi-monthly)

Coastwatch (Free)

105 1911 Building
North Carolina State University
Raleigh, NC 27650

Current Journal of Marine Education National Marine Education Association Masthead

Mid-Atlantic Marine Education Assoc.
Membership Services
P.O. Box 368
Lawrence, KA 66044
Membership and subscription \$15.00
to all.

Dover Publications, Inc.

180 Varick Street
New York, NY 10014
General catalogue, nature catalogue
and catalogues of other publications
and artwork available upon request.
Free.

Encyclopedia Britannica

Pamphlets (Free)
425 N. Michigan Avenue
Chicago, IL 60611

Marine Education (Free)

Marine Information Service
Sea Grant College Program
Texas A & M University
College Station, TX 77843

Marine Education Greetings (Free)

Marine Education Specialist
UNC Sea Grant
105 1911 Building
North Carolina State University
Raleigh, NC 27650

Maritimes (Free)

Graduate School of Oceanography
University of Rhode Island
Narragansett Bay Campus
Narragansett, RI 02882

National Geographic Magazine

National Geographic Society
17th & M Streets, NW
Washington, DC 20036
\$10.00 (monthly)

Natural History Magazine

The American Museum of Natural History
Central Park West at 79th Street
New York, NY 10024
\$10.00 (Monthly/Oct-May,
Bi-monthly/June-Sept.)

Information

New England Marine Advisory Service
University of Rhode Island
Narragansett Bay Campus
Narragansett, RI 02882
\$2.00 one time charge (Bi-monthly)

Oceans Magazine

P.O. Box 65
Uxbridge, MA 01569
\$12.00 (Bi-monthly)

Oceanus Magazine

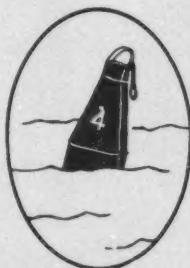
Woods Hole Oceanographic Institute
Woods Hole, MA 02543
\$8.00 (Quarterly)

Sea Frontiers & Sea Secrets
International Ocean Foundation
3979 Rickenbacker Causeway
Virginia Key
Miami, FL 33149
\$15.00 (Bi-monthly)

Skin Diver
P. O. Box 3295
Los Angeles, CA 90028
\$9.00 (Monthly)

Smithsonian Magazine
Smithsonian Associates
900 Jefferson Drive
Washington, DC 20560
\$10.00 (Monthly)

Underwater Naturalist
American Littoral Society
Sandy Hook
Highlands, NJ 07732
\$7.50 /student, \$10.00/individual,
\$12.00/family & library (Quarterly)



SECTION SEVEN

FILM COMPANIES

Film Addresses (Listed in Volumes I, II, III, IV Marine Educational Manuals)

BFA Educational Media
467 Severna Drive
Severna Park, MD 21146

Coronet Instructional Media
65 East South Water Street
Chicago, IL 60601

Churchill Films
622 North Robertson Blvd.
Los Angeles, CA 90069

Department of the Navy
Naval Education & Training
Support Center
Atlantic Commanding Officer
Naval Station; Bldg. 2-86
Norfolk, VA 23511

Encyclopedia Britannica
Educational Corporation
425 North Michigan Ave.
Chicago, IL 60611

EPA
Modern Talking Picture Services, Inc.
Central Distribution Office
2323 New Hyde Park Road
New Hyde Park, NY 11040

National Film Board of Canada
16th Floor
1251 Avenue of the Americas
New York, NY 10020

Harper and Row Publishers, Inc.
10 East 53rd Street
New York, NY 10020

Indiana University
Audio-Visual Center
Bloomington, IN 41401

Martin Moyer Productions
900 Federal Avenue
Seattle, WA 98102

McGraw-Hill
330 West 42nd Street
New York, NY 10036

Milner Fenwick, Inc.
3800 Liberty Heights Ave.
Baltimore, MD 21215

Motion Picture Service
Department of Commerce
NOAA
12231 Wilkins Avenue
Rockville, MD 20852

Paramount Oxford Films
8451 Marathon Street
Los Angeles, CA 90038

Shell Oil Co. Film Library
450 N. Meridian Street
Indianapolis, IN 46204

Time-Life Films
100 Eisenhower Drive
Paramus, NJ 07652

U.S.G.S. Films
Branch of Visual Services
303 National Center
Reston, VA 22092

SECTION EIGHT

NORTH CAROLINA FILMS

Agriculture Extension Service
N.C. State University
Raleigh, NC 27607
(919) 737-2861

Storm Tide (25 min.; color)

(This film has similar emphasis on coastal zone management
in relation to natural processes.)

Carolina Wetlands Project
1033 Wade Avenue
Suite 207
Raleigh, NC 27605
(919) 832-2971

America's Wetlands (28 min.; color)

(This film, a slide show and a variety of printed materials
on wetlands values and preservations available.)

Division of Public Affairs
N.C. Department of Natural Resources
and Community Development
P.O. Box 27687
Raleigh, NC 27611
(919) 733-3115

(Booklet provided on request of films, slide shows and talks
about natural resources.)

North Carolina Coastal Resources Commission
N.C. Department of Natural Resources
and Community Development
P.O. Box 27687
Raleigh, NC 27611
(919) 733-2293

Bogue Inlet: Study of Inlet Shifts (5 min.)

(Five-minute film on physical changes of Bogue Inlet
near Morehead City over a 20-year period.)

Office of Marine Affairs
119 Jones Street
Raleigh, NC 27611
(919) 733-2290

Our Living Coast (27 min.; color)

(Excellent photography of North Carolina coast, animals
and Marine Resources Centers.)



SECTION NINE

N.C. STATE GOVERNMENT RESOURCES

N.C. Department of Administration

Office of Marine Affairs
417 N. Blount Street
Raleigh, NC 27611

(919) 733-2290

The Office of Marine Affairs was established in 1972 to provide the necessary coordination in the planning and implementation of state and federal programs related to North Carolina's coastal and marine resources. The Office's goal is to insure a unified, integrated program for the development and use of these resources.

The OCS (Outer Continental Shelf) Task Force keeps abreast of off-shore oil drilling activities and any related onshore effects.

The Office also has the responsibility for the operation of the three North Carolina Marine Resources Centers which were constructed with funds provided by the state and the Coastal Plains Regional Commission. The centers are located on Roanoke Island; Bogue Banks; and at Fort Fisher, near Wilmington. Each has aquaria, marsh and seashore environmental trails, special marine environmental exhibits and an everchanging educational program.

N. C. Marine Resources Centers:

Roanoke Island
P. O. Box 967
Manteo, NC 27954
(919) 473-3493

Fort Fisher
Kure Beach, NC 28449
(919) 458-2257

Bogue Banks
Atlantic Beach, NC 28512
(919) 726-0121

Department of Agriculture

North Carolina State Museum
of Natural History
P.O. Box 27647
Raleigh, NC 27611

(919) 733-7450



The Museum conducts natural history surveys of all areas of the state with particular emphasis on the flora and fauna of the Outer Banks. The Museum is also conducting a long-term survey of the pelagic birds and marine mammals inhabiting our inshore and offshore waters.

Hampton Mariners Museum (919) 728-7317
120 Turner Street
Beaufort, NC 28516

The Hampton Mariners Museum interprets facets of North Carolina's relationship to the sea via exhibits, aquaria, ship models and programs. Displays of sea and shore birds, fish and mammal specimens and outstanding collections of North Carolina seashells greet the Museum visitor.

Department of Commerce

With regard to the relationship to Marine Science, the North Carolina coast and the coastal processes, the principal areas of activity would be in recommending sites located in and near coastal areas, marketing the available seafood processing facilities at Wanchese Harbor, and supporting utilization of the State Port facilities at Wilmington and Morehead City.

N.C. Seafood Industrial (919) 733-7651
Park Authority
Dobbs Building
430 N. Salisbury Street
Raleigh, NC 27611

The purpose of the North Carolina Seafood Industrial Park Authority is to promote, develop, construct and operate seafood industrial parks in the state. A seafood industrial park is a port and processing facility with the goal of promoting the development of seafood industrial activities by providing an operational base for: (1) landing and processing seafood products, and (2) necessary facilities and services to support the fishing industry within the park. In such a park, the state provides adequate land area and dock facilities under contractual agreements with seafood processors.

N.C. State Ports Authority (919) 733-6955
Room 523, Dobbs Building (919) 733-6956
430 N. Salisbury Street
Raleigh, NC 27611

The Ports Authority is engaged in the promotion and development of the seaports at Wilmington and Morehead City within the state and the stimulation of international commerce.

Travel and Tourism Division (919) 733-4171
Dobbs Building
430 N. Salisbury Street
Raleigh, NC 27611

This division provides information on coastal camping, accommodations, activities, tourist attractions, hunting and fishing, etc.

Department of Crime Control and Public Safety

Division of Emergency Management (919) 733-3867
116 W. Jones Street
Raleigh, NC 27611

This division is responsible for constructing and implementing various safety and evacuation plans for the state's citizens, including coastal evacuation plans in case of hurricane or other storm flooding.

Department of Cultural Resources

Division of Archives and History (919) 733-4763
Department of Cultural Resources
109 E. Jones Street
Raleigh, NC 27611

The publications section has many materials related to the historical coast. Ask for catalogue.

Underwater Archaeology Branch (919) 458-9042
P.O. Box 58
Kure Beach, NC 28449

The Underwater Archaeology Branch was created in 1972 by act of the State Legislature and mandated with the responsibility of protecting all submerged cultural resources which lie in North Carolina waters.

N.C. Department of Public Instruction

Division of Science Education (919) 733-3694
Education Building
114 W. Edenton Street
Raleigh, NC 27611

Division of Vocational Education (919) 733-7421
Trade and Industrial Education Section
582 Education Building
Raleigh, NC 27611

Trade and Industrial Education provides students with training and opportunities that are developmental rather than terminal, thus allowing maximum options for students, both male and female, to become employed or to continue their education in the post-secondary system. Students prepare for advanced entry level industrial careers through a sequence of learning experiences designed to enable them to achieve their highest occupational potential. The Public School System offers a number of courses that relate to Marine Occupation I, II & III; Commercial Fishing; Marine Mechanics; and Boat Construction and Maintenance.

Presently, there are eight such programs in the public school systems.
A list of the instructors and schools are enclosed for your convenience.

The purpose of these programs is to train people for the employment
needs of the area.

Mr. Brutus Begley & Mr. Wayne Holden
South Brunswick High School
Southport, NC 28461

Mr. Rozell Hewett
West Brunswick High School
Box 520
Shallotte, NC 28459



Mr. J.P. Miller
George West Vocational Center
9 South 13th Street
Wilmington, NC 28401

Mr. Owen Lupton
Pamlico County High School
Bayboro, NC 28515

Mr. Dewey Wells
Swansboro High School
Route 2
Swansboro, NC 28584

Mr. Frank Wheatley
Topsail High School
Hampstead, NC 28443

Mr. William Spender
Dixon High School
Holly Ridge, NC 28445

Department of Public Instruction

Division of Science Education
Division of Language Arts
Division of Social Studies
Education Building
Raleigh, NC 27611

Department of Public Instruction
TV Services
Raleigh, NC 27611

"What on Earth?," an instructional television series for eighth-grade earth science, is designed to complement a sequential course of study in earth science texts. Twenty-nine programs have been produced which are aired on educational television. Check TV Guide for schedule. Teacher's guides are available for each program along with slide packages keyed to scenes shown on the programs. These contain activities and resources.

Some programs are suitable for use in science classes above eighth grade. Several programs relate directly to concepts in marine education. These are listed below:

<u>Film Number</u>	<u>Program: Subject</u>
3	Forces That Act on the Earth: gravity and tides
8	Winds, Weather and Air Masses: local breezes found at land-sea interface and mountain valleys.
10	Cyclonic Storms: Pressure systems, fronts and the typical life cycle of a cyclone.
11	The Nature of Violent Storms: hurricanes with segments of "Connie," a major East Coast hurricane.
15	Science and the Sea Part I: Cruise on Duke University's research vessel, <u>Eastward</u> , covering techniques in navigation, sampling apparatus.
16	Science and the Sea Part II: continues to follow the cruise of R/V <u>Eastward</u> observing plankton tows, aquarium collection efforts and geologic dredging.
17	Land Versus Sea -- The Interface: waves, beaches, and seasonal beach change.
18	Land Meets Sea: shorelines around the world, aerial film from Maine, Alaska, Hawaii, California, Louisiana and North Carolina. A naturalist explains a transect across a North Carolina barrier island.
19	Man and the Sea: wind and sand dunes, philosophical look at North Carolina coastline and thoughts on future development.
27	Sedimentary Rocks: conditions for forming sedimentary rocks and ancient environments.
29	Geological Time: develops concept of time scale.

Department of Community Colleges

Division of Program Services
114 W. Edenton Street
Raleigh, NC 27611

(919) 733-6385

Seafood occupations training programs conducted in the Community Colleges System offer a series of occupational extension courses for North Carolina's fishing and seafood industries. These courses are available through the Continuing Education Divisions of the technical institutes and community colleges in the coastal region.

Department of Human Resources

Sanitation Branch
Environmental Health Section
Division of Health Services
P. O. Box 2091
Raleigh, NC 27602

(919) 733-2261

This branch works to establish preventive health care through protection of human food, water, air and shelters. Inspection of crustacea and shellfish are conducted. The processing, packaging and handling of such foods is also monitored. They also sample water supplies and oversee the proper handling of waste materials.

Shellfish Sanitation Program
P.O. Box 769
Morehead City, NC 28557

(919) 762-1543 - Wilmington
(919) 473-3957 - Manteo
(919) 726-6827 - Morehead City

The staff of the Shellfish Sanitation Program collects samples and makes bacteriological analyses of all coastal waters. This program provides for the inspection and certification of all shellfish, scallop and crustacea processors.

Department of Justice

Environmental Section
Attorney General's Office
Department of Justice
P.O. Box 629
Raleigh, NC 27602

(919) 733-5725

The Environmental Section of the Attorney General's Office provides legal interpretations of state statutes concerning environmental matters, e.g., water law, pollution laws, mining, well construction, dam safety, land use planning, ocean and fisheries laws, interpretation of the Coastal Area Management Act, Clean Water Bond Act grants, advice on Indian matters, etc.

Department of Labor

Apprenticeship Division
4 West Edenton Street
Raleigh, NC 27601

Phone Toll Free
1-800-662-7003

The Apprenticeship Division extends aid and information to those interested in participating in apprenticeship programs within the state.

Program offerings include such marine trades as boat building and motorboat mechanics. For further information, one might contact any local office of the N.C. Employment Security Commission.

Eastern N.C. - Supervisor
P. O. Box 201
Greenville, NC 27834
(919) 752-7304

Department of Natural Resources
and Community Development

N.C. Office of
Coastal Management
P.O. Box 27687
Raleigh, NC 27611

(919) 733-2293

The Office of Coastal Management is responsible for developing and carrying out a coastal management program based on legislative authorities at both the state and federal level.

The 15-member Coastal Resources Commission is a policy-making body responsible for implementing CAMA.

The larger 47 member Coastal Resources Advisory Council is made up of representatives of all the coastal counties, eight cities and the major state agencies and is responsible for advising the CRC and the Secretary of DNRC on all matters relating to coastal management.

Advice and information on coastal development is available at four locations: Raleigh (733-2293) and at three NRCD field offices -- Morehead City (733-2160); Wilmington (256-4161); and Washington (946-6481).

Division of Environmental Management (919) 733-7015
P.O. Box 27687
Raleigh, NC 27611

The Division of Environmental Management monitors environmental quality and regulates environmentally disruptive or pollution-producing activities. Its primary areas of authority are water and air resources.

Division of Forest Resources
P. O. Box 27687
Raleigh, NC 27611

(919) 733-7015

Upon request, advice concerning forestry management may be provided, free of charge, through foresters. Forests may be managed for income from timber, for wildlife, recreation, clean water or a combination of benefits.

Division of Land Resources
P. O. Box 27687
Raleigh, NC 27611

(919) 733-3833

The Division of Land Resources is composed of four sections: the Geological Survey, the Geodetic Survey, the Land Quality Section and the Planning and Inventory Section.

The Planning and Inventory Section encourages local land-use planning statewide and serves as staff to both the Land Policy Council and the Advisory Committee on Land Resources. Public education for conservation of the land resource is an important section concern. Located in the section is the Land Resources Information Service, a service which uses a computerized "Interactive Graphics System" to analyze and exchange geographically oriented land use, environmental, economic and social information with interested users. Land-use and land-cover data remotely sensed by NASA's Landsat Satellite will soon be included.

Main Office
Division of Marine Fisheries
P. O. Box 769
Morehead City, NC 28557

(919) 726-7021

The Fisheries Division is the only marine fisheries agency along the North Carolina coast that has statutory power to manage resources. If something is wrong, the Division can implement regulations very quickly in an attempt to solve problems. This is an important capability.

By law, the Division is responsible for the maintenance, preservation, protection and development of all marine and estuarine fisheries resources of the State of North Carolina. Their mission is to manage for optimum utilization by all citizens and to maintain a viable commercial fishing industry.

For any questions you have concerning marine fisheries regulations, or to contact your local marine enforcement officer, call toll-free 1-800-682-2632.

Regional Offices:

Division of Marine Fisheries
c/o NRCD Northeastern Office
P.O. Box 1129
Washington, NC 27889
(919) 945-5481

Division of Marine Fisheries
301 S. Causeway Drive
Wrightsville Beach, NC 28480
(919) 256-4541



Division of Marine Fisheries
315 S. Hughes Blvd.
Elizabeth City, NC 27919
(919) 338-8351

N.C. Wildlife Resources Commission
512 N. Salisbury Street
Raleigh, NC 27611

(919) 733-7123
1-800-662-7137
(Toll Free)

The Commission's professional staff is composed of five different divisions: Enforcement, Inland Fisheries, Game, Boating and Information and Education. Within these divisions are the biologists, technicians, wildlife enforcement officers, educational representatives, secretaries and others who keep the agency running on a day-to-day basis with the executive director leading the entire staff.

Division of Parks and Recreation (919) 733-7795
Natural Heritage Program
Box 27687
Raleigh, NC 27611

The Natural Heritage Program establishes a comprehensive, ongoing inventory of the state's natural diversity and plans for protection of significant natural areas.

Division of Parks and Recreation (919) 733-4181
P. O. Box 27687
Raleigh, NC 27611

The primary purpose of Parks and Recreation is to administer and manage the state park and recreation program so that an adequate supply of high quality recreation opportunities are made available to the people of the state and its out-of-state visitors. It is also designed to protect, preserve and conserve those unique natural, scenic and manmade features found across the state.

State Trails Program of the (919) 733-7795
Division of Parks and Recreation
P. O. Box 27687
Raleigh, NC 27611

This program provides information about trails for hikers, horseback riders, canoeists, bicyclists and off-road-vehicle enthusiasts. Currently, a statewide network of trails is being put together. The State Trails Program also urges the citizen to participate by supplying ideas and information about his interests.

Office of Water Resources
P. O. Box 27687
Raleigh, NC 27611

(919) 733-4064

Office of Water Resources
710 Arendell Street
Morehead City, NC 28557

(919) 733-4064

The Office of Water Resources provides grants to counties and municipalities to assist in beach protection, navigation improvements, and flood control projects.



Manley Midgett
North Carolina State University
Science Education

SECTION TEN

FEDERAL GOVERNMENT RESOURCES

1. U.S. Department of the Interior

Bureau of Land Management

Interior Building
C Street
Washington, DC 20240

Federal Water Pollution Administration

Washington, DC 20240

Fish and Wildlife Service

Washington, DC 20240

Geological Survey

Department of Interior Building
Washington, DC 20240

National Park Service

Division of Information
Washington, DC 20240

Office of Oil and Gas

Washington, DC 20240

Bureau of Outdoor Recreation

Division of Information
Washington, DC 20240

2. U.S. Department of Commerce

National Oceanic and Atmospheric Administration (NOAA)

National Oceanographic Data Center

Washington, DC 20235

National Ocean Survey (NOAA)

Rockville, MD 20852

National Ocean Survey

6501 Lafayette Avenue
Riverdale, MD 20854: Marine Charts

National Weather Service (NOAA)

Washington, DC 20240: Can provide hurricane tracking charts
and other weather awareness brochures.

NOAA

439 West York Street
Norfolk, VA 23510: (Information Booklets)

National Marine Fisheries Service

Washington, DC 20240

Office of Coastal Zone Management (NOAA)

Washington, DC 20240

National Wildlife Federation
1412 16th Street, NW
Washington, DC 20036

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20200: Free mailing of selected government
publications.

U.S. Department of the Interior

Cape Hatteras National Seashore
P. O. Box 457
Manteo, NC 27954
(919) 473-2117

U.S. Parks and Monuments Association has books, slides and other
education materials designed to support the Parks Program.

Cape Lookout National Seashore
Front Street
Beaufort, NC 28516
(919) 728-2250

Both national seashores have interpretative services and nature walks
and can provide other services for educational groups.

U.S. Department of Defense

U.S. Naval Oceanographic Office

Washington, DC 20373

Office of Naval Research

Arlington, VA 22217

For additional federal and state resources plus associations and conservation groups, write for Directory of Environmental Education Resources, Center for Environmental Education, 624 9th Street NW, Washington, DC 20001. (202) 737-3600.

SECTION ELEVEN

MARINE CAREERS RESOURCES

Publications

University Curricula in Marine Science and Related Fields

(No charge) Director, National Sea Grant Program, NOAA,
Department of Commerce, 300 Whitehaven Street, NW, Washington, DC 20235

So You Want To Be a Marine Scientist

Nuanu Seaquarium, Rickenbacker Causeway, Miami, FL 33149

Training and Careers in Marine Science

(50¢; free to IOF members) International Oceanographic Foundation,
10 Rickenbacker Causeway, Virginia Key, Miami, FL 33149

Opportunities in Oceanography

(\$1.25) Smithsonian Press, Smithsonian Institution, Washington,
DC 20560

Oceanography Information Sources

Printing and Publishing Office. National Academy of Sciences,
2101 Constitution Avenue, NW, Washington, DC 20418

The Oceans and You

(\$3.00) Marine Technology Society, 1730 M. Street, NW, Suite 412,
Washington, DC 20036

Marine Occupations in the Texas Coastal Zone

College of Education, Texas A & M University, College Station,
TX 77843

Occupational Outlook Handbook

U.S. Department of Labor, Bureau of Labor Statistics, Washington, DC 20212

Marine Career Series: Marine Related Occupations, A Primer for High School Students

Marine Advisory Service, University of Rhode Island, Narragansett
Bay Campus, Narragansett, RI 02882

The Need for Marine and Aquatic Education

Goodwin, Harold L.; Schaadt, James G., 1978. (Single copy free,
multiple copies \$1.00 each.) Available from: Sea Grant Communications
Office, College of Marine Studies, University of Delaware, Newark, DE 19711

Today's Youth in Tomorrow's Sea

Goodwin, Harold L. (Single copy free.) Available from: Bulletin Clerk, Oregon State University, Corvallis, OR 97331 - Request SG-45

The Marine Careers Project

(free) Available from: Education Department, Marine Careers Project, Central Wharf, Boston, MA 02112

Career Opportunities at the New England Aquarium

(free) Available from: New England Aquarium, Central Wharf, Boston, MA 02110

Zoo and Aquarium Careers

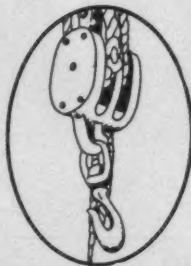
American Association of Zoological Parks and Aquariums (Free). Available from: New Jersey Marine Sciences Consortium, Fort Hancock NJ 07732

Employment Outlook for Oceanographers

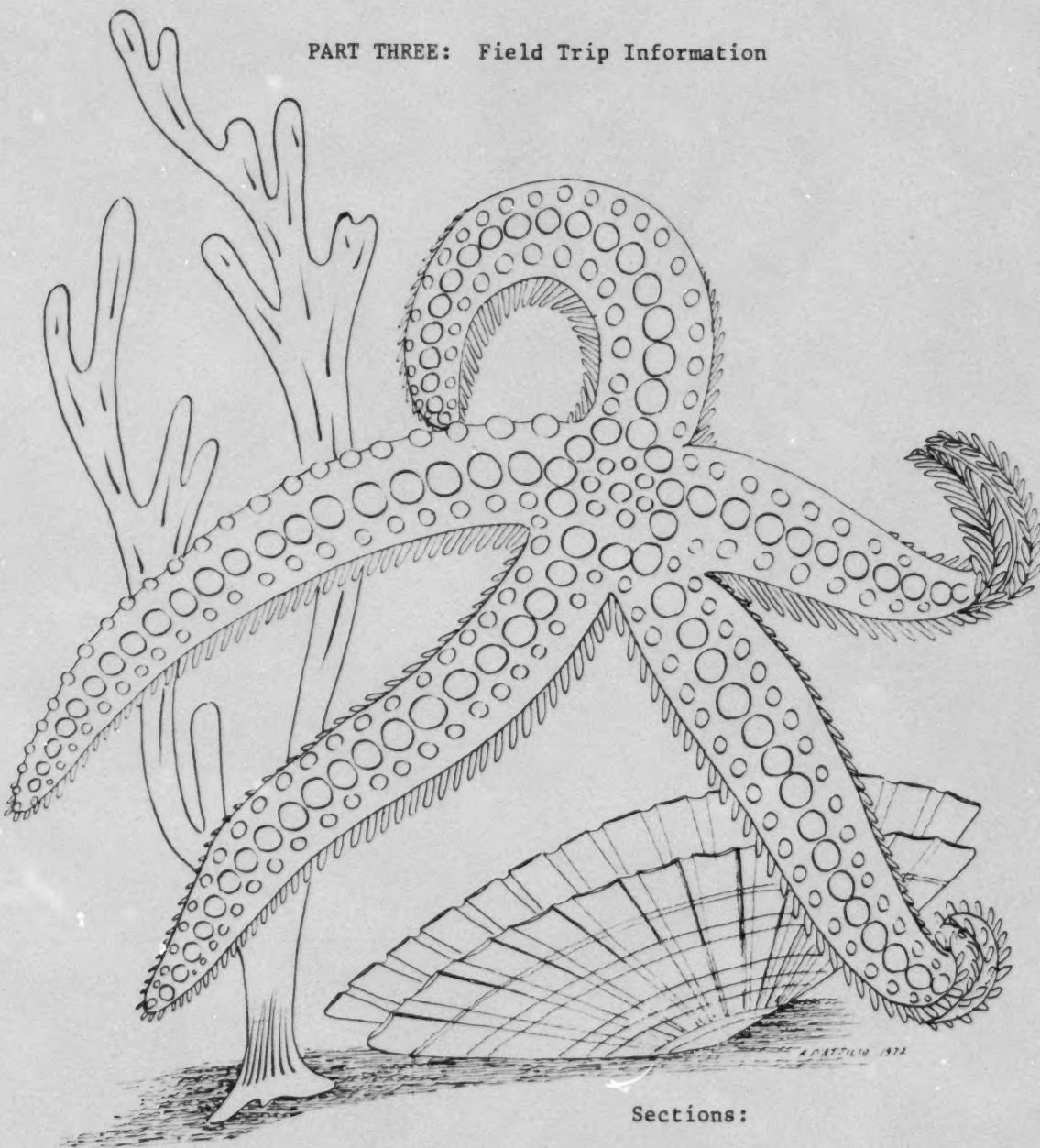
Occupational Outlook Quarterly
Bureau of Labor Statistics
Washington, DC

Your Future in Oceanography with the U.S. Navy Hydrographic Office

U.S. Navy Civil Service Commission
Washington, DC



PART THREE: Field Trip Information



Sections:

1. Shifting Sands
2. Statewide Field Trip Sites
and Resources
3. Reference Guides for Field Trips
4. Educators Field Trips
and Liabilities

C 1973 Dover Publications, Inc., NY. Seashore Life Coloring Book,
Illustrations by Anthony D'Attilio.

SECTION ONE

SHIFTING SANDS

A Guide to Coastal North Carolina for Teachers and 4-H Volunteers

"Shifting Sands" is a guide for the educator or 4-H volunteer who wishes to plan activities extending beyond the confines of school walls.

The idea of this material is to assist the educator in planning meaningful, educational field trips throughout coastal North Carolina. The guide provides the usual information on places to visit, how to get there, where to park, what to wear, expenses to expect, resource people to contact, tours available, reservations, exhibits to be seen, nature talks, walks and much more. Other information includes tips on available medical services, overnight accommodations and restroom facilities.

In short, this booklet was written by educators for educators and is hoped to be a useful source of information when planning for the beach trip.

The North Carolina coast can be divided into three geographical sections: I. Northeast to include northern Outer Banks, Currituck, Elizabeth City and Edenton; II. Middle to include Morehead City, Atlantic Beach and Beaufort; III. Southeast to include Wilmington, Southport and southern beaches.

The following is a list of places in our coastal area that may be visited on field trips.

I. Northeast Coastal North Carolina

1. Museum of the Albemarle
Route 17 South
Admission: Adults - 50¢, Children - 25¢
(919) 335-1453
Interesting exhibits of the coast's history.
2. Write Historic Albemarle Tours, Inc.
P.O. Box 124
Bath, NC 27808
(14 sites in northeastern North Carolina)
3. Historic cities of Edenton and Bath
Famous port cities of colonial importance, historic homes.
For information write: Chamber of Commerce, Bath, NC 27808
Historic Edenton, Edenton, NC 27932

4. Mattamuskeet National Wildlife Refuge
Route 1
Swanquarter, NC 27885
(919) 926-4021

Field trips, waterfowling, slide presentations and programs.
Staff endeavors to design trips or programs to meet individual
needs of various groups.

5. The Northern Outer Banks

Extending from Currituck south to Ocracoke Island make a
fantastic ecological and historic tour of coastal sights.
If you start from Ocracoke, taking the toll ferry either from
Cedar Island or Swanquarter, be sure to get the schedule
and make reservations ahead of time. Ocracoke: (919) 928-3841.
Cedar Island: (919) 225-3551. Swanquarter: (919) 926-1111.
(Name and vehicle license number are required for making
reservations.)

6. Wright Brothers National Memorial, Kill Devil Hills, NC
U.S. 158

Visitor center-museum, reconstructed hangar and shop, and air-
port mark spot where first powered aircraft flew on
December 17, 1903.

No charge

Facilities -- restrooms

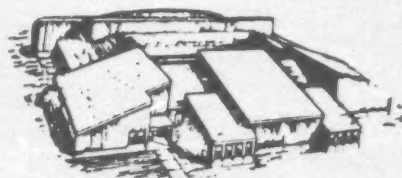
(919) 441-7430

7. Jockey's Ridge State Park, Nags Head beside U.S. 158.
Largest natural sand dune on the East Coast.

8. N.C. Marine Resources Center/Roanoke Island
P.O. Box 967, Airport Road
Manteo, NC 27945
(919) 473-3493

Facilities -- restrooms

No charge



Located near the site of the famous "Lost Colony," this facility
highlights the wind-swept beaches and dunes of the Outer Banks
and also the quiet backwaters of the sounds. Exhibits, films,
marine aquaria and displays about the coastal environment and
its organisms.

Guides lead field trips and provide "hands-on" educational
experiences.

Request a calendar of events. Ask an educator at the center
to design a field trip to meet your class or group needs.

9. Ft. Raleigh National Historic Site: Where Sir Walter Raleigh's
explorers and colonists discovered and laid out a town and
attempted to establish a settlement in 1584-87. Virginia Dare
born at this site. Visitor Center with displays, films, etc.
Ft. Raleigh National Historic Site Nature Trail: (919) 473-2117.
Manteo, NC on Roanoke Island.
No charge.

10. The Lost Colony Theatre, Manteo, NC. This outdoor drama is located at the Ft. Raleigh site.

Story of first English settlement in America. June 19 - August 26. Nightly except Monday in Waterside Theatre. Admission: Tickets - Adults - \$6, Children - \$3, Senior Citizens - \$4.

Business Office - (919) 473-2127

Gift and Souvenir Shop - (919) 473-3763

Ticket Office - (919) 473-3414

11. Elizabethan Gardens

Located at Ft. Raleigh, near Manteo, NC. Snow Garden, wild flowers, trees, plants and priceless pieces of antique statuary.

(919) 473-3234

Admission



12. Coquina Beach

8 miles south of U.S. 158

Picnic shelters, bath houses, good swimming. Beach walks with National Park Service naturalists.

13. Shipwreck Laura Barnes -- wrecked in 1921

Located on Coquina Beach

14. Bodie Island Lighthouse

8 miles south of U.S. 158

Visitor center with seashore information and natural history exhibits. Slide program.

No charge

Ample parking

Facilities -- restrooms

(919) 473-3991

15. Oregon Inlet Bridge

Spans Pamlico Sound and ocean inlet; three miles long.

16. Pea Island Wildlife Refuge

Between Oregon Inlet and Rodanthe.

Wildlife includes snow geese and many other species of waterfowl during winter months. Spring to autumn a large variety of wading, shore and upland birds. Overlooks parking areas.

Field trips upon prior request.

Write: Superintendent

Pea Island National Wildlife Refuge

Rodanthe, NC 27968

17. Cape Hatteras National Seashore

70 miles of open beach on Bodie, Hatteras and Ocracoke Islands

Camping is permitted on three campgrounds (five in summer).

Information on camping, education programs and shipwrecks.

Write: Cape Hatteras National Seashore

Route 1, Box 675

Manteo, NC 27954

(919) 473-2117

Nature Trail (near camping area): Good examples of plants, wildlife, freshwater swamps.

"Sand Castle" at Bodie Island. A children's nature center in South Nags Head, NC. (919) 441-6642

Buxton Woods

Nature Trail

Ample parking

Facilities -- picnic tables, no restrooms

18. Cape Hatteras Lighthouse

Located near Buxton, on Hatteras Island

Tallest lighthouse on American coast; open to public. Former keeper's residence is now a "Museum of the Sea."

Ample parking

Facilities -- restrooms

No charge

(919) 473-3991



19. "Museum of the Sea," Buxton, NC

(919) 995-5209

20. Ocracoke

Located at southern tip of Ocracoke Island on Route 12.

Picturesque fishing village community with accommodations.

Spot where Blackbeard the pirate was captured in 1718.

National Park Service Visitor Center available.

(919) 928-4531

Sites of interest at Ocracoke:

- Visitor Center
- Howard Street - one of the oldest streets on Ocracoke; good idea of what life was like before World War II
- Methodist Church
- Lighthouse - oldest operating lighthouse on East Coast
- British Cemetery
- Wahab Cemetery
- Wild Ponies of Ocracoke - about midway up the island there is a sizable herd of wild ponies. A lookout stand is available. It is commonly speculated that the animals descended from Barbary ponies left by St. Walter Raleigh's colonists.

Accommodations and Information

Numerous restaurants and motels are located along the banks.

For information contact:

Dare County Tourist Bureau

Box 399

Manteo, NC 27954

(919) 473-2138

Camping

National Park Service

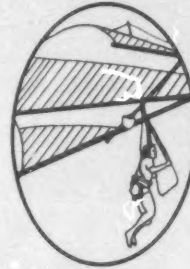
Campgrounds at Ocracoke, Frisco, Cape Point, Salvo and Oregon Inlet. For information and reservations call (919) 473-2117. Reservations required May 15 - September 6.

Private campgrounds are located on Nags Head Beach, Roanoke Island and Hatteras Island. Complete details available from Dare County Tourist Bureau.

Hyde County (Lake Mattamuskeet, Ocracoke Island)

Hyde County Coordinator
Swanquarter, NC 27885
(919) 926-5711

Dare County (Outer Banks, Manteo)
Outer Banks Chamber of Commerce
Box 202
Kitty Hawk, NC 27949
(919) 261-2626



II. Mid Coast

1. Aurora Fossil Museum, Aurora, NC

Resource facility teacher inservice and student field trips. The facility and staff provide an educational experience in coastal plain history, ocean levels, extinct creatures and sediment. Murals, films, tour of Texasgulf Corporation, "touch and feel" fossil samples and fossil scrip piles give opportunities for students to learn about geologic history and even bring home their own fossils. Open Wednesday, Thursday and Friday for school tours. For field trips, contact:

Chuck Hauser
P. O. Box 1157
Washington, NC 27889
(919) 946-4181

2. N.C. Eel Culture Project, Aurora, NC

Researchers have been studying methods of aquaculture at the N.C. Eel Culture Project. John Foster is the education specialist at the project and will be glad to show your group around. The purpose of the project is to promote aquaculture in North Carolina and develop new and better techniques for raising aquatic animals. Learn about backyard fish farming, clam gardening or raising eels.

Contact: John Foster
N.C. Eel Culture Project
Route 2, Box 305
Aurora, NC 27806
(919) 322-4054



3. Tryon Palace
610 Pollock Street
New Bern, NC 28560

In colonial times, New Bern was a thriving seaport and government center. In the elegant rooms of Tryon Palace and in the shadows of its walls, events that transformed a royal colony into an independent state took place.

Tryon Palace was known in colonial times as the most beautiful building in America. Restored to its former splendor, the palace reflects a royal governor's world as it existed in the decade of the American Revolution.

Special tours for children are designed to bring 18th-century life closer to the 20th-century young person. During the Child Life Tour, students participate in many of the same daily activities as colonial children did, such as carding, spinning and weaving. Colonial games and toys are also demonstrated. The Colonial Living Tour is designed for students of grades four, five and six. The young people observe and participate in using lighting devices, quill pens and other 18th-century objects. Selected rooms in the tour illustrate life for the upper, middle and servant classes in the colony. For more information concerning previsit activities, artifact kits and reservations, write:

Education Specialist
Tryon Palace Restoration Complex
P.O. Box 1007
New Bern, NC 28560

4. Hampton Mariners Museum, Beaufort, NC

The Hampton Mariners Museum in Beaufort interprets North Carolina's many faceted historical alliances with the sea. Down to the Sea is the theme of the museum commemorating both the maritime history and coastal natural history of the state.

Sea and shore birds, fish and mammal specimens, marine fossils and outstanding collections of North Carolina seashells are displayed throughout the museum. The museum boat shop displays restorations and reproductions of traditional wooden boats and visitors can watch actual construction of vessels.

Formal lectures or informal field trips in maritime history and marine natural history are offered throughout the year. Special programs must be pre-arranged. For more information contact: Judie Spitsbergen or Joann Powell

Hampton Mariners Museum
120 Turner Street
Beaufort, NC 28514
(919) 728-7317



5. Beaufort Historical Association
Guided tours through restored homes and businesses of Beaufort (fee). Pamphlet available for self-guided tour through cemetery. Possible double-decker bus tour if arranged prior to arrival. Contact: Beaufort Historical Association
138 Turner Street
Beaufort, NC 28514
(919) 728-5225
6. Beaufort Town Docks
Front Street

Walk the boardwalk and see boats of all uses: fishing boats, sailboats, power boats, research vessels (across the water at the Duke Marine Laboratory), sports fishing boats, menhaden fishing vessels, houseboats, etc. Note range markers, channel markers and other navigational aids.
7. Shackleford Banks, Bird Shoals, Carrot Island
Across from Beaufort, NC

A refuge for wildlife. Great for viewing birds and a variety of marine plant life. Wild ponies and goats roam the area freely. (Transportation to islands will be needed.)
8. Cape Lookout National Seashore - Headquarters at Beaufort, NC

Lighthouse and caretaker's dwelling still intact. Accessible by ferry or private boat. Beautiful shelling beaches, dunes and private lore. Ferry departs Harker's Island twice daily. There is a fee for the ferry as it is privately owned.
9. Harker's Island

Small island community which is the home of some of the biggest names in the U.S. in family boat building. Trips can be arranged to see this rare boat-building process taking place. Rose Brothers is the most famous.

Rose Brothers Boat Builders
(919) 728-2763
10. Duke University Marine Laboratory
Pivers Island
Beaufort, NC

The research vessel, NSF Cape Hatteras, is moored at the Duke Laboratory. Contact Eric Nelson for a possible tour and explanation of equipment aboard the vessel. (919) 728-2111.
11. North Carolina State University Seafood Laboratory
Morehead City, NC

The seafood lab investigates new methods of utilizing traditional and unusual seafoods. A slide/tape presentation explains the work being done at the lab. If arranged in advance, your group may learn to clean fish or shellfish. The lab also provides taste treats of unusual seafoods like shark, conch or squid.

For more information contact: Joyce Taylor
North Carolina State University
Seafood Laboratory
P.O. Drawer 1137
Morehead City, NC 28557
(919) 726-7341

12. Institute of Marine Science (adjacent to Seafood Lab)
3407 Arendell Drive
Morehead City, NC 28557 (919) 726-6841

View sea turtles in open tanks behind institute.
Arrange permission in advance. Contact: Joyce Lewis

13. North Carolina Division of Marine Fisheries
Morehead City, NC

The North Carolina Division of Marine Fisheries plays an important role in protecting our coastal fish and shellfish resources. Research is conducted to determine when fishing grounds should be opened and closed. Marine fisheries officers enforce fishing regulations. A public education representative can explain to your group the different types of fishing industries in North Carolina and the importance of protecting our renewable coastal resources. Programs may be designed for young children, as well as teenagers interested in fisheries careers.

Contact: Frances Hunter
N.C. Division of Marine Fisheries
3411 Arendell Drive
Morehead City, NC 28557
(919) 726-7021

14. North Carolina State Port at Morehead City, NC

One of the two shipping ports of North Carolina. Ships from around the world can be seen entering, loading and leaving the port. Tours can be arranged for groups.
No facilities
No charge
(919) 726-3158

15. Head Boat Fishing (Gulf Stream)
Captain Stacy II - \$40 per person
Morehead City, NC
Contact: Captain Stacy IV
(919) 726-4675



16. Fort Macon Historic State Park

Fort Macon is a restored pre-Civil War fort located at Atlantic Beach. Park historians lead tours and will show your group what life was like at the fort during the war.

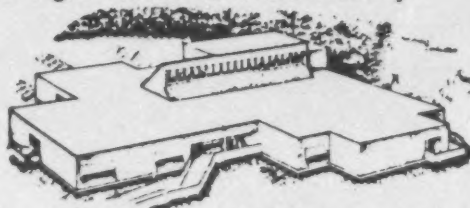
A nature trail meanders through a nearby maritime forest. Park naturalists will point out trees and shrubbery planted near the

fort that were used for the soldiers' benefit. Rock groins have been placed near the fort in an attempt to keep port channels open. A beach nourishment project is also in effect. Black fossil shells can be found along the beach. Currents are very dangerous in this area and no swimming is allowed. For more information contact:

Fort Macon State Park
P.O. Box 127
Atlantic Beach, NC 28512
(919) 726-3775

17. North Carolina Marine Resources Center/Bogue Banks

The Marine Resources Center at Bogue Banks is conveniently located near Atlantic Beach. Each year thousands of visitors come to the center to learn more about the marine environment through programs, exhibits and films. Field trips to a salt marsh, eel-grass bed or ocean beach highlight many group activities. Saltwater aquaria displaying local fish and invertebrates fascinate young and old. Open touch tanks allow visitors to become familiar with conchs, fiddler crabs and sea stars. Write to the center for a summer calendar of events:



North Carolina Marine Resources Center/
Bogue Banks
Atlantic Beach, NC 28512
(919) 726-0121

18. Theodore Roosevelt Natural Area

See unique plant/animal life of one of North Carolina's largest barrier island maritime forests. Self-guided trail winds among moss-draped live oaks, over relict dune ridges and along marsh. North Carolina Marine Resources Center is located within this beautiful 300-acre natural area and walks/slide programs may be arranged through them.

19. Hammock's Beach State Park, Bear Island

P.O. Box 58
Swansboro, NC 28584
(919) 326-4881

Spectacular dunes. Relatively uncrowded beach. Free ferry every 30 minutes -- Memorial Day thru Labor Day. Twenty minute ride on Intracoastal Waterway. Restrooms, concession stand, picnic areas, lifeguard. Highway 24 west from Swansboro about two miles, then follow signs.

20. Croatan National Forest

The most "coastal" of any National Forest in eastern U.S. The Croatan Forest has many unusual attractions. The unusual include

many species of animals, birds and plant life seldom seen elsewhere. Unique to this forest are the area of pocosins. Animal wildlife include egrets, hawks, bald eagles, peregrine falcons, osprey, deer, alligators, black bears and migratory birds, such as ducks and geese. Picnic areas are available. The Cedar Point Tideland Trail is located across from Swansboro at the mouth of the White Oak River. Trail meanders through pine and hardwood forests crossing tidal marshes on cypress boardwalks. Viewing blinds are along trail to observe wildlife. Ask for map and "Insect Eating Plants" brochure. For information:

U.S. Forest Service
435 Thurman Road
New Bern, NC 28560
(919) 638-5628



Accommodations and Information

Carteret County Chamber of Commerce
P.O. Box 1198
Morehead City, NC 28557
(919) 726-6831

Onslow County
Jacksonville Chamber of Commerce
Box 765, Hwy. 17
Jacksonville, NC 28540
(919) 347-3141

Craven County (New Bern)
Chamber of Commerce
317 Middle Street
New Bern, NC 28560
(919) 673-3111

III. Southern Coast

A. Wilmington and Wrightsville Beach

1. University of North Carolina at Wilmington
(919) 791-4330

Contact Biology Department Office for marine science tour. Take a tour of this beautiful "college by the sea." Students can tour the various departments of the college and special demonstrations or talks may be given by the instructors there if arranged well in advance. There is an excellent marine science program which could spark enthusiasm for your stay at the beach. Instructors are often willing to give short field trips if their schedules allow.

Facilities -- restrooms and drink machines.

2. New Hanover County Museum
814 Market Street (Hwy. 17)
Wilmington, NC 28401
(919) 763-0852

Small, but packed with history of nature and man. The purpose of the New Hanover County Museum is to collect, preserve and interpret lower Cape Fear natural and social history through exhibits and programs. Write for brochure listing all educational programs.

No charge

Facilities -- restrooms, gift shop, free parking, handicap access, picnic area if arranged in advance.

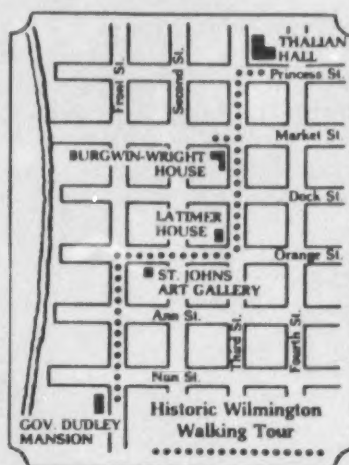
3. Historic Wilmington Walking Tour

Take a walk into the past; let your mind wonder and your imagination be your guide. See the old home sites as you walk the streets of historic Wilmington. (Write to the

Wilmington Chamber of Commerce

for the pamphlets "Old Wilmington, NC" and "Old Wilmington Guide Map.")

Tour begins at Thalian Hall with an audio-visual presentation. Walking tour takes you to Thalian Hall (restored classic 19th-century community theatre), Burguin-Wright House (colonial gentleman's town residence), Zebulon Latimer House (elegant 19th-century residence), St. John's Art Gallery, and the Governor Dudley Mansion (home of first elected North Carolina governor). After the Governor's Mansion, there is transportation back to Thalian Hall, or you can have your own transportation meet you there.



Old Wilmington, Inc.
P.O. Box 1862
Wilmington, NC 28401

Admission fee

Hours--10:00 a.m. to 5:00 p.m.

Tuesday thru Saturday

Tour takes 2-4 hours

4. St. John's Museum of Art
114 Orange Street
Wilmington, NC 28401
(919) 763-0281

Located in a former church, the gallery houses a treasure of Southern art.

Admission fee

Hours--10:00 a.m. to 5:00 p.m.

Tuesday thru Saturday

2nd & Orange Streets.

5. First Presbyterian Church
3rd and Orange Streets
Wilmington, NC 28401

Good example of Cathedral-type architecture with rose window and beautiful stone work.

6. Oakdale Cemetery
520 North 15th Street
Wilmington, NC 28401
(919) 762-5682

A quiet place to reflect on the past. Cemetery is 117 years old. There is a tour of specially selected sites of interest marked by arrows. Tour includes characters such as Rose O'Neal Greenhow, famous Confederate secret agent; Hon. Edward Dudley, first elected governor of North Carolina; Henry Bacon, architect of the Lincoln Memorial and many others. Good place to do tombstone rubbings.

No charge

No facilities

7. Cape Fear Technical Institute
411 North Front Street
Wilmington, NC 28401
(919) 343-0481

One part past, two parts present, one part future; Cape Fear Tech blends the culture and history of old Wilmington in a modern facility educating our youth for the future. Good trip for students: the library is a museum in itself. Furnishings are modeled after 18th-century tavern. Guide is very good with students who thoroughly enjoy their fascinating visit to library.

Students take tours right into classrooms and labs. Excellent opportunity to show them various programs continuing education has to offer. An underwater habitat is on display.

The school uses several boats to train students in the Marine Technician Program. Students learn navigation, sampling techniques and equipment maintenance aboard. Training cruises are also taken. Ask for permission to possibly tour the boats.

No charge -- weekdays only

Facilities -- restrooms

Parking in lot beside new building.

8. The Cotton Exchange
North Front Street
Wilmington, NC 28401

A bale of fun wrapped in history! Located near Cape Fear Technical Institute, across the river from Battleship North Carolina.

The Cotton Exchange is a commercial area, almost like a mini-mall.

It is designed like old Wilmington and set on the Cape Fear River.

A good place to go after touring Cape Fear Technical Institute.

There is an old-timey ice cream shop!

Near Coast Guard ice breaker Northwind.

Ample parking in front of Nutt Street.

9. Chandler's Wharf
Wilmington, NC 28401
On the river, Chandler's Wharf features the largest and most unique collection of historic sailing ships and commercial workboats in the southeast area as well as a nautical museum, restaurant and riverboat cruise. Open all year, 9:00 a.m. until sunset. Foot of Ann and Water Street.
10. Greenfield Gardens - Municipal Park
South of Wilmington on U.S. 421
(919) 763-9871
Are you ready for a picnic or just a place to relax and unwind? Greenfield Gardens is the answer. It's spacious, scenic and relatively quiet. The kids can run, explore or just relax under a shade tree around this beautiful cypress lake.
No charge
Facilities -- picnicking, refreshments, restrooms
Parking lot beside park suitable for buses
11. USS North Carolina (Battleship)
North of 421; intersection U.S. 17, 74, 76 and NC 133
(919) 762-1829
Battleship is set up just as it would be when in action. Students explore all through the ship. They can read historical documents, view all aspects of life on board and let their imaginations run wild.
Admission fee
Facilities -- restrooms, snack machine
12. Intracoastal Waterway Bridge at Wrightsville Beach
U.S. 74 east of Wilmington
Good area to observe local fishing, floundering and crabbing. Best at night. Small amount of parking. Park and walk under bridge. Sandy area suitable for small groups. Sandy beach leads into marsh area. Make sure students have long sleeves, long pants, shoes, socks and insect repellent.
13. Wrightsville Marina
Wrightsville Beach, NC 28480
Good for sketching and observing small- to mid-sized boats (privately owned). Good view of Intracoastal Waterway Bridge. Shrimpers can be observed on the mainland side of causeway.
No charge
No facilities
Contact dockmaster
14. Office of Saline Water, Wrightsville Beach Test Facility
Wrightsville Beach, NC 28480
The saline experimental water station shows how government and science join dollars with knowledge in an attempt to find a solution to the fresh water shortage by looking towards the sea.

Tour begins with film on various test facilities, purposes, processes and benefits. Guide will lead students through test facility, labs and outdoor set ups. Students even get to taste water distilled at the plant. Parking available in front of the plant. Brochures available for you and students.

No charge

Facilities -- restrooms

15. International Nickel (INCO)
Wrightsville Beach, NC 28480
(919) 256-2271

International Nickel is a big corporation with research trying to find metals that will resist corrosion. This facility clearly shows how scientific experiments must stand the test of time and how large corporations such as INCO must be willing to spend large sums of money to develop a competitive product. Tour begins with film, then leads into museum of various materials and tests and continues into test facilities and labs. Open to junior-high and high-school groups.

No charge

No facilities

Contact Earl Baker well in advance

16. Masonboro Jetty

Location: South end of Wrightsville Beach. Drive until road ends. There is a small parking area where the road loops around at the end.

****Potentially dangerous field trip site with no swimming allowed.**

At the south end of Wrightsville Beach, there exists two rock jetties placed by the Corps of Engineers in hopes of keeping the inlet open. Whether the jetties do more harm than good is a question that's not clearly understood. A good place to discuss beach dynamics and beach restoration projects taking place in the area.

No charge

No facilities

17. Shell Island
Northern end of Wrightsville Beach

You need to enter beach at Johnny Mercers Pier or get permission to park at the Holiday Inn. Limited parking also along road. Walk is approximately three miles.



Excellent beach walk. If you time it at low tide you will be able to explore many tidal pools. Good to walk up the beach and back on the same road behind the dune where you walk the marsh edge back. Great for observing marsh life. This is a scarcely used section of the beach.

There are no facilities so make sure all needs are taken care of at pier.

18. Moores Creek National Military Park

Location: 20 miles outside of Wilmington. Take Hwy. 421 north from Wilmington. Take left at Hwy. 210 when it intersects 421. Follow this until you see the battleground signs.

Moores Creek, several acres of hills rolling in Revolutionary War history and covered with the finery of nature. There is a well-done museum with rangers available to show classes around.

No charge

Facilities -- restrooms, drink machines, picnic areas

Hours -- open daily 8:00 a.m. to 5:00 p.m.

B. Southport

1. Orton Plantation

If you have got the time and budget, Orton is a must stop. Beautiful gardens and plantation house depict how the elite in early North Carolina lived. Also, it is a good area to study coastal plant and animal life. Walking the road that leads into the plantation makes an excellent nature walk affording good opportunity to point out bird life. In pond just before getting to Orton you see many trees with osprey nests. You might even get to see an osprey!

Orton Plantation Gardens
Winnabow, NC 28479
(919) 371-6851
Admission fee
Facilities



2. Carolina Power and Light Nuclear Energy Plant
(919) 457-6041

Location: Just outside of Southport. Parking available beside visitors' center.

Engineers say it's power for the people. The visitors' center shows the entire process from the reactor to the home. They explain the cost and tell us to conserve. Many audio-visual and manipulative displays set in ultra-modern atmosphere.

Suggested activities: Teachers, why not tell your students about the question of the likelihood of geological faults, the altering of coastal ecology, the availability of fissionable materials for future use and safety measures and standards imposed on this plant? After discussing these things, ask your students for their reactions to questions like economics vs. ecology, how to conserve electricity, or alternative power sources.

No charge

Facilities -- restrooms, picnic tables

3. Old Southport Cemetery
Cemetery dates back to 18th century. Ideal for historical investigations and tombstone rubbings.
No charge
No facilities

C. Carolina Beach Area

1. Southport - Ft. Fisher Ferry

Summer Schedule Southport

7 a.m. 1 p.m.
9 a.m. 3 p.m.
11 a.m. 5 p.m.

Ft. Fisher

8 a.m. 2 p.m.
10 a.m. 4 p.m.
12 a.m. 6 p.m.

Winter Schedule Southport

8 a.m. 1:30 a.m.
11 a.m. 3:30 p.m.

Ft. Fisher

9:30 a.m. 2:30 p.m.
12:30 a.m. 4:30 p.m.

Ahoy, mates! Why not cast off and take a ride that's really a trip. Twenty to twenty-five minutes of salty adventure with the North Carolina Department of Transportation's ferry service from Southport to Ft. Fisher.

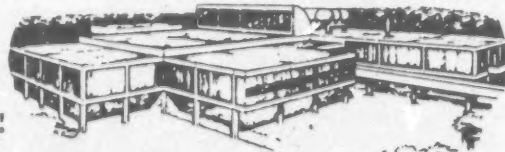
P.S. Don't forget to post your lookouts for herons, egrets, loons, the brown pelican, or if you're lucky, the water turkey!

2. Carolina Beach State Park
P.O. Box 475
Carolina Beach, NC 28428
(919) 458-8206

Located in a pine forest just outside Carolina Beach. Ask park ranger to talk with students about the area.
Facilities -- water hook-ups, bath house.

3. North Carolina Marine Resources Center/Ft. Fisher
General Delivery
Kure Beach, NC 28449
(919) 458-8247

A million-dollar facility with a million things to do! Here are just a few of them.
Field trips to the beach, marsh and rocky outcrop are available to groups. Exhibits, films, a large touch pool and nature trail are also available. Request a printed trail guide and summer calendar of events. Ask the education coordinator to help you design your field trip.
No charge
Facilities -- restrooms.



4. Ft. Fisher Museum
Kure Beach, NC 28428
(919) 458-5538

Here's one you won't want to miss. See how science works to preserve our past. Excellent historical museum concerned mainly with the Civil War. Short film will be shown.

Parking in front of museum.

No charge

Facilities -- restrooms

Hours -- Tuesday thru Saturday, 9:00 a.m. to 5:00 p.m.

Sunday, 1:00 p.m. to 5:00 p.m.

Accommodations and Information

The Greater Wilmington
Chamber of Commerce
P.O. Box 330
Wilmington, NC 28402
(919) 762-2611

Pleasure Island
Chamber of Commerce
Drawer A
Carolina Beach, NC 28428
(919) 458-8434

Southport/Oak Island
Chamber of Commerce
Route 1, Box 52
Southport, NC 28461
(919) 457-6964

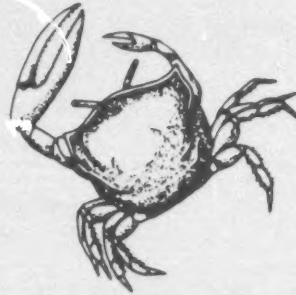


The North Carolina Baptist Assembly, a religious retreat and conference center, is located on the mouth of the Cape Fear River, south of Wilmington. The Assembly occupies what was once Fort Caswell, a military installation with over 150 years of importance in our country's history. The primary purpose of the Assembly is to provide religious retreats for North Carolina Baptists. The Baptist Assembly will, however, accommodate non-profit groups and will gladly lodge 4-H and school groups as space is available. An auditorium, dining facilities and lodging are available February through November. For more information contact: Reservations Office

North Carolina Baptist Assembly
100 Caswell Beach Road
Southport, NC 28461
(919) 278-9501

Southport and Brunswick County
Resources Development Commission for Brunswick County
P.O. Box 638
Southport, NC 28461
(919) 457-6356

Wrightsville Beach
Wilmington Chamber of Commerce
Waynick Blvd.
Wrightsville Beach, NC 28480
(919) 256-2308



Acknowledgements

Thanks for preparations and editing: 1st edition, Mary Olson and Charlie Baker; 2nd edition, revisions and additions, Jaynee Medlicott.

SECTION TWO

STATEWIDE FIELD TRIP SITES AND RESOURCES

There are several field trip sites across the state that offer exciting marine and aquatic programs for youth. Touch tanks, marine aquaria and exhibits can be found from the mountains to the coast. Take advantage of the opportunity to explore a sample of the ocean in your own neighborhood!

Federal and State Fish Hatcheries in N.C.

A visit to a North Carolina fish hatchery is a great opportunity for young people to learn how federal and state agencies are working to stock our rivers and streams with fish. Watch brood fish being artificially spawned, see how fish eggs are incubated and cared for, feed a trout some trout chow!

Both cold and warm water species are being raised in North Carolina. If contacted in advance, hatchery personnel will be glad to give your group a tour of the hatchery and explain its function. Ask the manager to explain how the hatchery attempts to preserve our natural resources and meet the needs of recreational fishing. (Contact the hatchery well in advance to find out when some of the most exciting activities, i.e., spawning or stocking will occur.)

Federal Hatcheries

Edenton Fish Hatchery
P.O. Box 329
Edenton, NC 27932
Manager: Elliott A. Atstupenas
(919) 482-4118
(Striped Bass)

Pisgah National Forest Fish Hatchery
P.O. Box 158
Pisgah Forest, NC
Manager: T.R. Chastain
(Trout)

McKinney Lake Fish Hatchery
Hoffman, NC 28347
Manager: Lloyd D. Wright
(Bluegills, Largemouth Bass)

State Hatcheries

Armstrong Fish Hatchery
Route 3, Box 234
Marion, NC 28752
(704) 756-4179
(Trout)

Fayetteville Fish Hatchery
Route 4, Box 395
Fayetteville, NC 28304
(919) 867-6390
(Bass, bluegill, striped bass)

Marion Fish Hatchery
Route 6, Box 685
Marion, NC 28752
(704) 652-4040
(Trout)

Tablerock Fish Hatchery
Route 5, Box 348
Morganton, NC 28655
(704) 437-3977
(Trout, Tiger Muskie)

Waynesville Fish Hatchery
Route 1, Box 624
Waynesville, NC 28786
(704) 456-8758
(Trout)

Museums and Science Centers

Catawba Science Center
406 - 3rd Avenue, N.W.
Hickory, NC 28601
(704) 322-8169

(Saltwater aquaria, shell collections, programs)

Department of Cultural Resources
109 Jones Street
Raleigh, NC 27611
(919) 977-2111



Discovery Place
301 North Tryon
Charlotte, NC 28202
(704) 372-6261

(Thematic exhibits, large aquariums, touch tanks, "Aquapod" informal demonstrations of marine science-related topics)

Division of Archives and History
Publications
109 E. Jones Street
Raleigh, NC 27611
(919) 733-7442

Hampton Mariners Museum
120 Turner Street
Beaufort, NC 27408
(919) 728-7317

(Museum interprets North Carolina's many faceted historical alliances with the sea, as well as its coastal natural history. Sea and shore birds, marine fossils, ship models, and traditional boat building are all displayed at the museum. Field trips and lectures are available to the public. Write for museum brochure.)

Natural Science Center
4301 Lawndale Drive
Greensboro, NC 27408
(919) 288-3769

(Marine Programs offered November-March only.
Touch tanks, Marine programs & films.)

Nature Science Center
Museum Drive
Winston-Salem, NC 27105
(919) 767-6730

("By the Sea" - marine animals of the tidal
zone, touch tanks, slide show, "We Care
About Oceans".)

Rocky Mount Children's Museum
1610 Gay Street
Sunset Park
Rocky Mount, NC 27801
(919) 977-2111

(Marine fossils, shells, dioramas, talks.)

Schiele Museum of Natural History
1500 E. Garrison Boulevard
P.O. Box 953
Gastonia, NC 28502
(704) 864-3962 or 865-6131

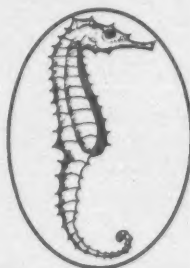
(Marine exhibit in spring, field trips,
films and library. Outreach program
takes museum resources to schools,
churches and community clubs.)

Western North Carolina Nature Center
Gashes Creek Road
Asheville, NC 28805
(704) 298-5600
Call between 1 - 5 p.m. Wednesday-Friday

(Marine Environment Exhibit
January 30 - April 11.
Touch tanks and a variety of
marine programs.)

North Carolina State Museum
of Natural History
Bicentennial Plaza
Raleigh, NC 27611

(Marine mammals, fish, &
shell exhibits.)



SECTION THREE

REFERENCE GUIDES FOR FIELD TRIPS

Amphibians & Reptiles of the Carolinas and Virginia. Martof, Palmer, Bailey & Harrison. University of North Carolina Press, Chapel Hill, NC. 1980.

Audubon Water Bird Guide. Pough. Doubleday and Company, Inc., Garden City, NJ. c. 1951.

Barrier Island Ecology of Cape Lookout National Seashore. Godfrey & Godfrey, National Park Service. No. 9.

Birds of the Carolinas. Potter, Parnell & Teulins. The University of North Carolina Press, Chapel Hill, NC. 1980.

A Checklist of Marine Fishes of Beaufort, North Carolina. Ross. Duke University Marine Laboratory Reference Museum, Beaufort, NC.

A Checklist of Common Invertebrate Animals of Beaufort, North Carolina. Gray & Kirby-Smith. Duke University Marine Laboratory Reference Museum, Beaufort, NC. 1977.

Common Jellyfish and Comb Jellies of North Carolina. Institute of Marine Sciences, University of North Carolina, Morehead City, NC 28557. 1979.

Discovering Your Environment. Ashton & White. N.C. State Museum of Natural History, State Department of Public Instruction, Raleigh, NC.

The Ecology of Intertidal Flats of North Carolina: A Community Profile. Peterson & Peterson. Information Transfer Specialist, National Coastal Ecosystems Team, U.S. Fish & Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Boulevard, Slidell, LA 70458. 1979.

The Ecology of Intertidal Oysters Reefs of the South Atlantic Coast: A Community Profile. Bahr & Lanier. Information Transfer Specialist, National Coastal Ecosystems Team, U.S. Fish & Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Boulevard, Slidell, LA 70458. 1981.

Euell Gibbons' Beachcomber's Handbook. David McKay Company, Inc., New York, NY. 1972.

A Field Guide to the Atlantic Seashore. Gosner. (Peterson Field Guide Series.) Houghton Mifflin Co., Boston, MA. 1979.

- A Field Guide to Edible Wild Plants of Eastern and Central North America. Peterson, Lee. (Peterson Field Guide Series.)
- Fossil Vertebrates - Beach and Bank Collecting for Amateurs. Thomas. 22 Larkspur, Hendersonville, NC 28739. c. 1968, 1977.
- From Currituck to Calabash. Pilkey, Neal, Pilkey & Riggs. 2nd Edition. North Carolina Science and Technical Research Center, Research Triangle Park, NC 27709.
- A Guide to Common Marsh Plants of North Carolina. Wilson. UNC Sea Grant. \$1.50.
- Guide to Beach Field Trip Activities. A collection of 24 measurement investigations. \$3.50. Project CAPE, Post Office Box 640, Manteo, NC 27954.
- Guide to Some Trawl-Caught Marine Fishes From Maine to Cape Hatteras, North Carolina. NOAA Technical Report NMFS Circular 431, Flescher. 1980. U.S. Department of Commerce, National Oceanic & Atmospheric Administration, National Marine Fisheries Service, Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.
- How to Live with An Island: A Handbook to Bogue Banks. Pilkey, Pilkey & Turner. North Carolina Science and Technical Research Center.
- The Living Land. Schumann. Dale Press, Chapel Hill, NC. 1977.
- New Hanover Banks: Then and Now. Cleary & Hosier. UNC Sea Grant Publication UNC-SG-77-14. 105-1911 Building, Raleigh, NC 27650. 1977.
- The NC Marine & Estuarine Mollusca - An Atlas of Occurrence. Porter. UNC Institute of Marine Sciences, Morehead City, NC 28557. 1974.
- Pocosin Wetlands. Richardson. Hutchinson Ross Publishing Co., Stroudsburg, PA. 1980.
- Sea Shells Common to North Carolina. Porter. UNC Sea Grant. \$0.75.
- Seacoast Life. An ecological guide to natural seashore communities in North Carolina. Spitsbergen. N.C. State Museum of Natural History.
- Spring Comes to the Roanoke. Manooch. Era Press, Davidson, NC. 1979.
- Tidal Marshes: The Boundary Between Land and Ocean. FWS/OBS-80/15. (A concise, up-to-date look at tidal marshes of the U.S.) Available free by writing: Information Transfer Specialist, National Coastal Ecosystems Team, U.S. Fish and Wildlife Service, NASA-Slidell Computer Complex, 1010 Gause Boulevard, Slidell, LA 70458.
- The Tide Marsh Guide. Roberts. E.P. Dutton Co., New York, NY. 1979.

Vegetation and Ecological Processes on Shackleford Banks. Au. Nation Park
Monograph Service. No. 6.

Wild Flowers of North Carolina. Justice & Bell. The University of North
Carolina Press, Chapel Hill, NC. c. 1968, 1979.

Wildflowers of the Outer Banks. The Dunes of Dare Garden Club. The Univer-
sity of North Carolina Press, Chapel Hill, NC. 1980.

Golden Guide Series. Inexpensive, informative pocket size books. Avail-
able at book stores.

Birds
Ecology
Evolution
Fish

Fishing
Oceanography
Seashells
Seashores

Zoology



SECTION FOUR

EDUCATORS, FIELD TRIPS AND LIABILITIES

Many school administrators have eliminated field trips from their curriculum because of (1) the high cost of transportation, (2) the increasing difficulty of disciplining students, (3) the "back to basics" idea, and (4) the increasing frequency and expense of liability suits. Another reason for the demise of the educational field trip is that some teachers have used it simply as a method for getting out of the classroom with little or no plan to integrate it with the curriculum. This relates directly to the liability problem, since the poorly planned and executed field trip not only gives field trips a bad name, but also leads to increased potential for a liability suit. This article will suggest ways to avoid the liability problem and also will demonstrate to school officials that statistics show academically-related field trips are actually a minor source of liability suits.

Legal Trends: Two legal trends that affect all school activities, including field trips, recently have developed. First is the large number of tort cases (breach of duty) brought against schools and teachers across the country, partly because schools in most states can no longer consider themselves immune from litigation under the old doctrine of "sovereign immunity."

Research by Alexander (1971) and Krepel et al. (1977) shows that little if any of the current increase can be attributed to field-trip activities. Based on the number of reported injuries, the "danger spots" that may lead to litigation are interscholastic athletics, playground activities, physical education and shop classes. In a survey by Duval and Krepel (1978) the question "Have you had any recent court decisions regarding teacher responsibility and liability in the matter of field trips?" was asked of 50 state attorneys general, a sample of state superintendents of instruction and some of the leading education associations. Only in Kentucky was there a field-trip-related incident, and the court refused to consider the matter since the drowned victim was over 18 years of age.

The second trend is increased amounts of claimant damages sought in liability cases. Lawyers for plaintiffs seem to use the "deep pocket" approach in their claims, which increases the incentive to sue, as well as the cost of settlements.

Legal Responsibilities of the Educator: Howard (1968) states, "Teachers are personally liable to pupils for injuries occurring because of teacher negligence." Putting this point in perspective, Schimmel (1972) comments, "What Mr. Howard fails to point out is that every citizen is personally liable for injuries that occur because of negligence." The principles of liability are the same for all citizens. However, to avoid being considered professionally negligent, a teacher must prudently plan and carry out activities for students.

Hoffman (1970-71) quotes the Supreme Court of Wisconsin: "Teachers are generally held in high regard by the courts, and both statutory and in the case law reflects this interest. However, teachers are presumed to know the laws and the policies established by their local district's board of education." Teachers should consider it part of their responsibility to become familiar with state liability laws. Teachers should also ask the advice of the school district's legal counsel before planning special programs or activities. Above all, they should not hesitate to contact the state's attorney general for advice.

When an accident occurs that leads to a suit, the attorney for the plaintiff (the victim or guardian) must prove three points. First, it must be proven that the educator did not perform the assigned or assumed duties correctly; legally, this is referred to as "breach of duty." Did the educator act with reasonable care, or as any prudent teacher would have done under similar circumstances? Second, the breach of duty must be shown to have contributed to the injury. Could circumstances leading to the injury have been avoided by preplanning, or through actions the teacher could have taken? Third, the attorney must prove that there was contributory negligence on the part of the plaintiff. Was the possibility of the accident increased by the behavior of the child? This third point is related directly to the age of the child. Younger children are legally less responsible for their actions than are older children.

How Not to be Negligent on a Field Trip: Not all teachers should consider using field trips as part of their program. They should be avoided by those who are not organized, have poor control over students, or are uncomfortable outside the classroom environment. Principals and other school administrators should identify and separate these teachers, as well as those who would use field trips merely to get out of the classroom from those who see the field trip as a legitimate part of an innovative program.

The first step in avoiding liability suits is a good, written plan which the principal should use to evaluate the field trip to decide just how many students could participate effectively and safely. All too often, administrators do not like to adjust schedules, and teachers thus may be expected to accommodate too many students for a safe meaningful experience. This is especially a problem for field trips to natural environments. The following steps should be taken in planning a field trip:

A. Pre-trip Planning

1. Develop clear goals for the field trip.
 - a. How does the field trip relate to ongoing studies?
 - b. What activities before and after the trip could be developed around it?
2. Select an appropriate site.
 - a. The teacher should decide what facility or natural area will best suit the needs of the students. A trip to a museum, zoo or aquarium may be more helpful than a trip to a marsh to study fish. On the other hand, if the object is to study coastal ecology, it would be better to visit the natural environment.

b. Never take students to a site that you have not personally visited.

- A site should be safe and easily traversed by students.
 - Know the restrictions on use of land and get written approval from landowners. Note: Liability of the landowner varies according to the accessibility of the property. If it is private property not in commercial use and you receive permission, the landowner's responsibility is the same as previously mentioned on personal liability. If the owner has a commercial concern that people pay to visit, his or her liability can be much greater.
 - Preview activities planned for your students. You cannot, for example, estimate the depth of water and mud in a salt marsh creek just by looking at it, and an untried seining exercise could be very dangerous for students.
 - Be sure to coordinate your activities with the proper officials if visiting a museum, park or other facility. Many of these areas have interpretative naturalists or educators that can provide programs or other assistance.
 - Be aware of local conditions such as weather and tides that might create a problem.
 - When possible, locate people who are knowledgeable about the area and seek their advice or assistance on the trip.
3. Be sure to bring and use proper equipment. Train students in the use of special equipment.
4. Have enough help. One adult for 10 secondary or one for 5 primary students is suggested, or one for 5 primary students is a suggested ratio. Select only responsible adults who are interested in the program and will actively supervise. Do not use chaperones who insist on bringing other family members, especially younger children.
5. Prepare a fact sheet for parents and students which includes activities, itinerary, instructions on clothing, expected behavior. High-risk activities like scuba diving, snake collecting and mountain climbing should be explained thoroughly. Parents should be required to sign the sheet to indicate that they have read the information. This does not waive their right to sue; it just demonstrates that the teacher provided information to the parents.

6. Require a simple health form asking about allergies (e.g., bee stings) or ailments that may occur on the trip. The name and phone number of each student's physician and a home phone number should be included. These health information sheets should be taken along on the trip. They can be invaluable in an emergency.
7. Develop an emergency plan. If there is an accident, know where to get help, especially from life squads and hospitals. Go over the plan with your assistants so that everyone knows what to do.
8. After planning is complete and all information prepared, obtain official approval for the trip. Go through proper channels according to school or institutional policy. This is a very important point that could be reviewed in court.
9. Safe, appropriate transportation is the responsibility of the teacher, but liability in case of accident usually lies with the driver of the vehicle. Plan activities during travel, including stops on the way at points of interest. The time in a bus or car can be used to prepare students for the experiences they are about to have.

B. Executing the Plan

1. Follow your written plan; try to avoid major unplanned activities.
2. Keep chaperones informed and involved in the program. They should be particularly aware of their roles in all activities.
3. Follow emergency procedures in case of accident. If an accident occurs, avoid unplanned communication with the press; let school officials handle this sensitive area.
4. Keep students under control at all times. The legal definition of control varies with student age. Elementary student's must be under voice control of the teacher or chaperone at all times.
5. Be aware of student's needs; do not get so involved in activities that you lose touch with the group.
6. Parents and students should be informed in advance that behavior that could lead to injury will not be tolerated and that students who misbehave will be sent home by the school administration. One way to approach this problem is with a written student contract that specifies what the teacher expects the student to achieve and how the student is to behave on the trip.
7. Free time should be structured and chaperoned. Avoid athletics or activities in the "high-risk" range of potential liability.

C. Post-Field-Trip Activities

1. Use the field-trip activity as part of the classroom learning experience.
2. Use the press on campus (school newspaper) and in the community to tell others about the field experience. Community support for such projects will encourage reluctant administrators.

Conclusion. Literature on school liability and interviews with insurance company officials and other experts indicate that field trips have produced no more liability cases than activities carried out in the traditional classroom. Therefore, the argument often used by school officials that field trips are too hazardous has little basis in fact.

However, the possibility of suit-producing accidents in the field is real and should never be taken lightly by field-trip leaders or administrators. All field-trip leaders should be aware of their legal responsibilities when developing a field-trip plan. Once developed, the plan should receive written approval from the appropriate authority and should be reviewed by participants and their guardians. Field-trip leaders should keep records of their plans, official approval, accident reports, adult witnesses and professional liability insurance. Most of all, field-trip leaders must maintain control and common sense.

References

- Alexander, Kern. 1971. Tort liability spreads to students, faculty. National Schools, No. 3:55-58.
- Ashton, Patricia S. and Ray E. Ashton, Jr. 1978. A practical guide to field trip planning. Mimeo available from North Carolina State Museum of Natural History, Raleigh, NC.
- Davis, Elaine C. 1971. Tort liability of teachers and school administrators. Education Horizons: 40-4.
- Duval, R. Charles and Wayne J. Krepel. 1972. Teacher liability during field trips. Journal of law and education, 11:4:637-48.
- Hoffman, Earl. 1970-71. The classroom teacher and school law. Educational Horizons: 33-9.
- Krepel, Wayne J. and Charles R. Duval. 1977. Field trips: laws and court cases. Unpub. thesis. 64 pp.
- Schimmel, David. 1972. A teacher's liability may be less than you think. School Management. No. 16:34-5.



Lundie Spence
Marine Education Specialist
UNC Sea Grant College Program

Ray E. Ashton, Jr.
Director of Education
N.C. State Museum of Natural History